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Importance of Ductility As a Working Property of Glass

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In previous articles we considered the part played by temperature gradients in the manufacture of glassware. We cannot go far with the solution of any glass-working problem without meeting the unequal cooling question and this might well be a subject for an indefinite amount of discussion. However, a great many other elements enter into and control our glass-working processes. One of the most important of these is ductility.

When describing glass at its working temperatures one must make a great many explanations and exceptions, as glass is so different in its behavior from other materials that words coined to describe these other materials are found incomplete in their meaning when applied to glass. A mold charge of glass is usually referred to as a "plastic mass" or a "plastic body," but glass is not plastic in the same sense that clay, putty, plaster, etc., are plastic. It is a heavy viscous liquid and must be worked as such.

Ductility enters into practically every important glass working process. Even in pressing where one would least expect to find any use or consideration given to this property of glass, a close study reveals that the design of our press molds is controlled largely by the ductility of glass. To explain the part that ductility has in the art of pressing one must consider that at room temperature glass is a solid possessing neither ductility, plasticity, nor malleability. As soon as glass leaves the furnace it begins to solidify. At first only the surface is affected by the reduced temperature. This makes it necessary for us to consider the mold charge as being in the form of a bag, the exterior of which is made up of viscous material, and the inside contents being in a more liquid form. This outer layer will stretch under tension, but will crush and buckle under compression. To work successfully the mold must be so designed that the surface of the glass is being constantly increased throughout the filling of the mold. This is done by making the mold in three essential parts, mold body, stripper ring, and plunger.

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The customer usually has little knowledge of the design of glass press molds but designs his glass to suit his needs and the glass manufacturer has to redesign the article to conform with the known methods of glass working, because of this particular property of glass.

The press shops also utilize the ductility of glass to reduce the size of the shear cut by drawing out the neck of the glass before shearing.

In finishing pressed ware ductility plays an important part, for articles such as swing out vases are drawn out from blanks only a fraction of the length of the finished ware. Also the better grade of pressed plates are pressed as bowls, the edges of which are drawn out and shaped by means of a buffer. This warming in and working of the glass restores its natural brilliancy.

The art of glass blowing is dependent upon ductility for its existence. The glass blower not only makes use of the ductility of glass to expand his blank by blowing but also draws the blank out to suit the shape of the mold by swinging to elongate. The stem ware workers make use of ductility to produce some of the most attractive table and decorative wares. By catching the tip of glass between the blades of his procellas or tools, the workman draws out the slug of hot glass on the outer end of the blank to produce the slender graceful stems of sherbets, goblets, etc. Many attempts have been made to imitate this class of ware by pressing, but the resulting product has been very coarse and clumsy in comparison.

A familiar sight in connection with a press or blow shop is a handle setter who takes a gathering of glass on a punty and presses it to the article then lifts the punty to draw the glass out to the proper length. He then clips the glass near the punty and, with a pair of tools, sticks the free end of the handle to the article and by further drawing shapes the handle. When carefully made these handles will bear the closest inspection as they are practically free from surface defects and have a finish never equalled in mold formed

glassware. The spout maker is not so well known as the handle setter but his work is much the same. He places a small quantity of glass on the side of a blown article still on the pipe. He then blows into the pipe to form a hollow ball on the side of the article, and with a pair of tools, the spout is drawn out and shaped from this bulb of hot glass.

Ductility makes possible practically all the off-hand glass working. Today the offhand worker produces but little of the utility glassware and confines his labors to the production of decorative and high grade table ware. With a few simple tools and fire he fashions our most beautiful glassware, and here again we find an absence of those surface defects so common to molded glass.

When passing through a blowing room where a number of shops are working on small ware one will notice the small threads clinging to the shadow pans and the furnace doors. Occasionally one may feel a pulling sensation across the back of the hand or on the face caused by one of these threads so small as to be invisible except when held in the light. Very few substances possess greater ductility but as yet this particular property has found no great commercial use. Special equipment has been devised to draw this fine thread and some cloth has been woven from the finest threads while the coarser ones have been used in making Christmas tree ornaments. By use of a steam jet, a cheap grade of glass has been blown into a room to produce a wool-like heat insulating material for covering steam pipes and similar purposes.

Within the last few years the manufacture of cane and tubing of glass has become one of the important branches of the glass industry. The processes developed to manufacture cane and tubing can be divided into two main classifications, horizontal and vertical drawing. All methods of producing cane and tubing by drawing of course depend upon the ductility of glass for their success. The hand process has almost vanished except for the production of tubing composed of two or more glasses such as thermometer tubing and special gauge glasses.

In the vertical machine drawing the tubing is drawn from a pool of glass surrounding a clay tube through which air is supplied to form the bore. The horizontal machine drawing is a somewhat later development and consists of flowing a small stream of glass onto the upper end of an inclined, rotating clay mandrel through which air is supplied. The glass coming off the lower end of this mandrel is caught up and fed between a pair of endless belts to a cutting off device where it is separated into short lengths. Both machine methods are continuous and very rapid. In neither of the machine methods is the glass touched by any tool or mold to shape it. The glass sets with a surface so perfect that it can be instantly distinguished from molded glass. The size of the tubing and its wall thickness are controlled by the temperature of the glass, speed of the drawing unit, and the air supply. By eliminating the air supply these machines will produce cane.

The surface tension of the molten glass in combination with its ductility makes the formation of cane and tubing by drawing quite simple but when the solution of the problem of manufacturing sheet glass by drawing was first attempted this same surface tension caused these experimenters to spend years working out their equipment. The glass we know as window glass is produced by three outstanding methods all of which depend upon the ductility of glass for their success. The drawn cylinder split into shawls and flattened in ovens is the oldest of these methods. The other methods may be described as horizontal and vertical sheet drawing. In both of these methods of sheet glass drawing the glass is drawn vertically from the bath of glass, but in one the ribbon of glass is bent over a roll to pass through a horizontal lehr while in the other the glass is drawn vertically through a vertical annealing unit. The width of this ribbon of glass is maintained by two very ingenious but distinctly different methods. In the horizontal machine the edges of the glass are caught between knurled rollers set at an angle to the line of travel of the glass so as to keep pulling the edges of the sheet outwardly.

In the vertical drawing the glass flows upwardly through a slot in a boat-like clay float placed on the surface of the pool of glass. This glass is caught and fed into a continuous drawing machine. These processes do not appear complicated; but years of experimenting were nevertheless required to bring them to the point where they were considered a commercial success. The knurled rollers give the sheet of glass an undesirable edge that has to be cut off and returned to the tank as cullet. The sheet of glass from the vertical drawing machines also has an edge differing from the body of the sheet in that it is somewhat heavier and has a beaded edge. A number of uses have been found for this glass so that it is not entirely a waste.

When examining a small piece of drawn glass of good quality and weight one might believe it to be plate glass. But when held to reflect the light a slight waviness of the surface is noticeable. This unevenness of the surface may be traced to the lack of homogeniety of the glass or poor temperature control, either of which effects the viscosity of glass and also its ductility.

These examples cited here do not cover the methods that have been worked out to use ductility as a working property of glass but will serve to show its importance.

In practically every class of glassware, used in any volume, two or more methods have been worked out to produce each particular line of ware. The methods of glass working that make the fullest use of ductility produce the best appearing and except in a few cases the most serviceable glassware made by hot glass working methods.

When working out a method of producing a new article of manufacture to be made of glass one may be able to greatly improve the appearance and character of the product by spending some time considering the possibilities of those methods of glass working that have the greater dependence upon ductility for their success.

THE AMERICAN ARBITRATION YEAR BOOK, 1927, published by the American Arbitration Association, New York, is the first of its kind to be issued in this country. It tells American business men and members of trade associations when and how they can secure arbitration. It tells what such arbitration will cost, what rules will govern the decision, and the steps to be taken to put the award into effect. It points out the increasing practice of resorting to this method of settling disputes and points out that arbitration does not mean compromise; that most disagreements can be arbitrated immediately, privately and inexpensively.

Fuel Economy in Glass Works Practice

By T. C. Moorshead

THOMAS COURTNEY MOORSHEAD, technical director and general manager of The United Glass Bottle Manufacturers, Ltd., London, and sixth president of the Society of Glass Technology, was formerly chief engineer and later assistant general manager in charge of engineering and manufacturing for the Illinois Glass Company, of Alton, Illinois. He became connected with the British company in 1919 in a technical advisory capacity. In 1923 he was appointed general manager and the following year was elected a director of the company. He was responsible for the introduction there of the latest methods of glass mass production. The United Glass Bottle Manufacturers, Ltd., has an annual output of about 250 million glass bottles, ranging in size from one-ounce vials up, and of great variety of shapes, including milk bottles, mineral water, proprietary and patent medicine bottles, etc. The Company, of which E. A. Coad-Pryor is director of research, is doing pioneer work to develop new and improved methods affecting every detail of glass manufacturing processes related to bottle making.

FUEL economy in the glass industry is rather a complex question because, contrary to what may probably be the prevalent opinion, the glass industry covers many and diverse ramifications not only in the character of processes involved, but also in the nature of the product, and it would therefore hardly be practical to discuss the question of fuel economy in the industry as a whole.

Fuel is a very important factor in the production of glass, for in a modern plant the minimum amount of coal required to produce a ton of glass is about 1.25 tons, including all of the auxiliary requirements, such as power, lighting and annealing, and where the load factor of the melting furnace may be low, for reasons which are often unavoidable, the coal consumption will run as high as 2.5 tons per ton of glass produced.

The percentages of fuel used for the various phases of the operations in a bottle factory are approximately as follows:

	Per Cent
Melting	60
Power	18
Annealing	16
Heating and auxiliary processes	6

At the Charlton factory of the United Glass Bottle Manufacturers, Limited, where in the whole of the operations fuel oil is used, and where completely automatic mass production machines are employed for the manufacture of the bottles which are produced at this factory, the percentages of power in the various phases of the operating process are as follows:

	Per Cent
Melting	59.2
Annealing	16.2
Electrical energy	8.7
Heating and auxiliary purposes	6.3
Compressed air for oil atomization	4.5
Compressed air for Owens machines	2.3
Vacuum for Owens machines	2.8

In this factory one ton of finished ware is produced for an average of 0.8 tons of oil, the minimum being 0.71. This, however, is not a very high efficiency, as it is possible in this factory, with a maximum possible load factor on the furnaces, to produce a ton of finished ware on 0.6 tons of oil, including everything, but it has not been possible to attain this maximum efficiency because of the general character of the work and commercial reasons, which often make it necessary to manufacture small bottles and of light weight, thereby pulling a very low tonnage from the furnaces and reducing the melting efficiency accordingly.

In the melting process where approximately 60 per cent of the total fuel is used, the average thermal efficiency is only about 16 per cent, this figure dropping sometimes to as low as 12 per cent, and increasing to 20 per cent.

Such a comparatively low thermal efficiency may at first glance appear to leave considerable room for improvement, but when the various conditions which govern this operation are analyzed, it will be seen that the losses are very difficult to overcome, when having regard for the practical phases of the problem.

Melting Processes

There are five principle factors which determine the efficiency of the melting process. The size and dimensions of

This article was prepared by Mr. Moorshead for the 1927 edition of the Fuel Economy Review of the Federation of British Industries.

the furnace in proportion to the glass melted, the nature of the fuel, the composition—and more especially the color—ot the glass being melted, the age of the furnace, the temperature of the external surroundings. In addition to these we have to consider also the skill with which the furnace is operated: that is to say the control of the combustion to minimize the quantity of excess air used in burning the fuel. All these factors influence the efficiency very profoundly.

In discussing the economics of glass melting, volumes could be written, but as our space is limited, we can only outline a few of the factors that enter into this phase of the operations, and discuss them briefly.

In a tank furnace, the heat balance for an oil fired tank works out approximately as follows:

	Per Cent
Heat utilized for melting the glass.....	20
Heat lost: By radiation from sight holes, etc.	2
Up stack	25
By radiation from crown....	15
Side walls	7
Bottom	7
Regenerators, flues to stack..	24

This balance is drawn up for a furnace operating under efficient working conditions, that is to say, working continuously, melting about a ton of glass per twenty-four hours per 12 square feet melting area. A coal fired furnace will, of course, not show such high efficiency, since we have to take into consideration the producer losses which may amount to from 25 to 30 per cent.

Before considering the possibilities of a reduction in working costs, it will be of interest to describe briefly to what extent the various factors mentioned above influence the performance of the furnace:

Size of Furnace Relative to Glass Melted

For every size of furnace there is a maximum efficient load and the efficiency of the furnace depends very largely on whether it is working to maximum capacity. For a furnace melting colorless glass we find that a variation of 10 per cent on the glass being melted, only affects the fuel consumption by 1.2 per cent. Supposing, therefore, a furnace was melting 20 tons of glass per day with a consumption of 10 tons of fuel, we could melt 30 tons per day with a consumption of 10.6 tons of fuel, that is to say, in the former case we were melting 2 tons of glass per ton of fuel, whereas with the increased load we were melting 2.8 tons of glass. It is clear, therefore, that the melting efficiency depends on the suitability of the furnace for the tonnage of glass to be melted. If it were possible for a furnace to be running always at its maximum capacity the costs of melting would, in many cases, actually be halved. Unfortunately, the dimensions of the furnace have to be designed for peak loads and the efficiency will depend on the difference between the peak and the average load—a matter which is largely controlled by the commercial phases of the business.

Roughly speaking the melting capacity of a furnace is proportional to the area of the floor of the melting furnace. A reasonably good performance is to melt one ton of glass per twenty-four hours per 12 square feet of melting area. If one ton is melted per 10 square feet of melting area, the life of the furnace is not appreciably affected. If, however, a furnace is pushed harder and one ton per 8 square feet melting area is melted, the life of the furnace may be shortened by 25 per cent and one ton per 6 square feet may halve the life of the furnace. The ratio of load on the tank to fuel consumption given above does not hold with any accuracy if the load on the tank much exceeds one ton per 10 square feet melting area.

Fuel

The relative efficiency of burning the coal and oil is a complex question, depending largely on producer efficiency; probably on melting costs oil fuel, operated under any conditions, is more economical than bad producer practice, but less economical than an up-to-date well run producer plant. But as the relative costs are so largely determined by the ruling prices of fuel delivered at the works, discussion of the relative economies is out of place here.

Color and Composition of Glass

It is obvious that a glass which requires a high furnace temperature must be more expensive to melt. Glasses which have a quick setting rate; that is to say, once they melt, become fluid at temperatures only a comparatively short way above their softening point, are easy to melt. On the other hand, glasses which increase in fluidity very slowly with a rise in temperature are more difficult. The difference in the cost of melting hard glasses and soft glasses as manufactured commercially, is probably of the order of 5 per cent.

The color of the glass also exercises a marked influence on the furnace efficiency. Glasses which contain appreciable quantities of certain ingredients, notably iron, are comparatively opaque to heat rays, with the result that less heat is radiated from the furnace down through the glass, and lost through the sides or bottom of the melting tank.

Comparative figures taken over four years of operation in the cost of melting two glasses of similar composition, except for less than ½ per cent of coloring materials, showed that the cost of melting the colorless glass is approximately 10 per cent greater than colored glass. These comparisons were made in furnaces of similar dimensions and operating under similar working conditions.

Age of Furnace

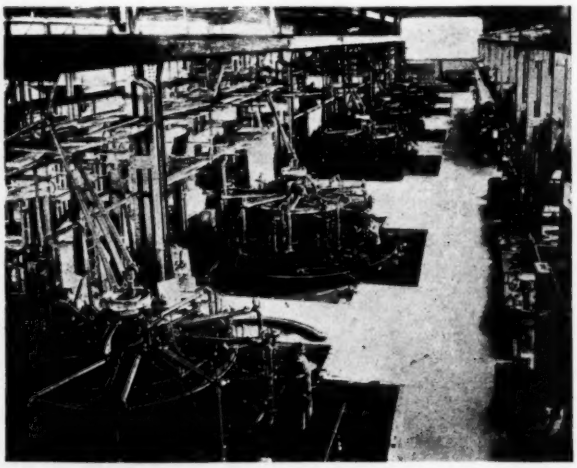
As the furnace grows old, the blocks from which it is built begin to wear thin. Since the temperature on the inside of the tank is kept constant, and the outside does not vary very greatly, it is obvious that the flow of heat through the walls will be roughly proportional to the thickness. We find from a mass of statistics on the subject that the fuel consumption increases roughly 2 per cent for every month's life of a furnace. This figure relates to colorless glass, since the heat does not penetrate through the glass to the walls of the furnace with colored glasses. There are other reasons why an old furnace is inefficient, for example, when the regenerators choke up, but this inefficiency generally makes itself felt in the inability of a furnace to operate under a high load factor, rather than an increase in the actual amount of fuel used. We have had amber furnaces in operation for over a year and consuming no more fuel than when new.

Temperature of the External Surroundings

The weather is found to make an appreciable difference to furnace efficiency. In a well-housed glass factory it is probably the mean daily temperature which makes the most difference, since the moisture in the glasshouse itself would not vary very much with the external conditions, and the wind, although affecting exposed parts of the factory, would not be likely to have very much effect on the efficiency of the furnace itself. Taking the mean daily temperature (shade temperature) over a period of three years and comparing this with the oil consumption of a works, we find that a difference of 5 deg. F. in temperature affects the fuel consumption 1 per cent. The mean summer temperature at Charlton is approximately 20 deg. above the winter temperature, and we find that at this plant the fuel consumption is 4 per cent lower in the summer than in the winter.

Furnace Manipulation

In a modern plant, equipped with up-to-date methods of control, we need not find great wastage in fuel due to mishandling the melting furnace proper. The excess air can be cut down to less than 20 per cent. On a furnace where



INTERIOR VIEW OF THE CHARLTON PLANT

the control is not very good, we may find losses in efficiency amounting to as much as from 20 to 30 per cent, due to lack of adequate control.

From the above considerations it is clear that to compare the efficiency of two furnaces operating under different conditions is extremely difficult and for this reason the tabulation of furnace efficiencies has never been carried out successfully to any great extent in the glass industry, and it is only in recent years that we have been able to obtain any reliable data on which to study the effect of furnace design and operating conditions on fuel consumption and by this means increase the efficiency of melting.

Considering the factors affecting the efficiency outlined above, it is clear that most progress lies in designing a furnace to melt a large quantity of glass with the minimum superficial area: that is to say, a furnace with a high load factor. A certain amount of economy can be obtained by careful insulation. Referring to the balance sheet above it will be noted that the loss by radiation from the crown is given as 15 per cent. This is rather above the average: perhaps a more usual figure would be 12 per cent. Since the silica bricks used in the crown have a liberal safety margin in fusibility, we can probably save a considerable amount of fuel in this way. If it were possible to insulate the whole crown, we should save approximately 40 per cent of this heat: that is to say, 40 per cent of 15 per cent, i.e., 6 per cent of the furnace fuel. It would be risky, however, to insulate the whole crown, since the end of the furnace through which the raw materials are charged would probably wear very quickly if the inside of the crown reached too high a temperature. The soda ash (sodium carbonate) in the batch is highly corrosive and in filling on the batch it is difficult to avoid a certain amount of dust. We can probably save, therefore, only from 3 to 4 per cent.

Experiments are at present being made in this direction, to see how far the saving in fuel balances the increase in the depreciation of the crown. It has not been thought practicable to insulate the sides of a furnace which are exposed to the molten glass. A rise of 50 deg. C. in the temperature of the side walls would increase the rate of corrosion of the fireclay blocks by at least 100 per cent. The insulation of the bottom of the furnace is, however, possible, since the blocks on the bottom do not run very hot. The temperature gradient in the glass with a furnace melting colorless glass is of the order of 10 deg. C. per inch of depth: that is to say, with a tank 40 inches deep the temperature on the bottom is about 1,000 deg. C. if the tank is running at 1,400 deg. C. Raising this to 1,200 deg. C. would do no great harm; on the other hand, we should only reduce the furnace losses by less than 1 per cent.

The collection and systematic tabulation of such data referred to above has, in the glass industry, only been undertaken within the last few years, in this country at any rate, and already the assimilation of such knowledge is beginning to bear fruit. The overall fuel consumed per ton of glass at Charlton during the past year has decreased by 3.4 per cent.

Modification in furnace design alone has within the last two years enabled us to increase our furnace efficiency by 10 per cent (our normal flint tanks under our average load melted 2.9 tons of batch per ton of oil. Two furnaces of special construction on which experiments were being tried out recently melted on the average load 3.2 tons of batch per ton of oil). This improvement of 10 per cent in the efficiency was obtained without altering the load factor on the furnace. By running the furnace nearer its peak load we have been able to melt over long periods (some weeks) over 5 tons of glass batch per ton of oil—a quantity unheard of a few years ago. This represents a melting efficiency of 32 per cent—a remarkable performance in furnace practice, in view of the fact that the glass has not only been melted, but maintained at its refining temperature (1,400-1,450 deg. C.) for about 100 hours.

Annealing Process

As stated in the table above the average percentage of fuel used in the annealing process is 16 per cent, but during the past few years a considerable amount of research work has

been carried on to discover a practical means of utilizing the heat available in the bottles for heating the annealing furnace, and quite recently we have been able to build a lehr which it is hoped will eventually operate with no supplementary heat at all.

The problem is largely centered around the method of conveying the bottles through the annealing furnace. Calculating the heat lost through the furnace walls we find that if the bottles are put in straight from the machine, they contain roughly twice the amount of heat necessary for balancing the heat lost through the walls of the furnace, providing draughts down the annealing furnace are not excessive. It has always been necessary to use some form of an endless belt on which the bottles are carried through the furnace. This belt, of course, cools down with the bottles as they pass through the lehr, and consequently is fed back into the hot end of the lehr comparatively cold. The heat required to raise the temperature of a comparatively heavy iron belt or chain is very considerable, far in excess of the heat available in the bottles.

We can either, therefore, attach to a well insulated tunnel, a supplementary furnace for heating the chain, or we could endeavor to make an extremely light chain. The experiments we have already carried out have reduced the cost from 3/- to 1/6d per ton of large bottles.

Quite recently a conveyor has been designed which dispenses with all moving parts which are cooled with the bottles and required subsequent heating.

By this device we hope to be able to cut out fuel costs in the annealing process entirely, and, with the aid of an efficient system of thermal insulation, to conserve the heat in the bottles as they come through the machine. By this means it is hoped to save upwards of 5,000 tons of oil a year at the Charlton factory.

Auxiliary Processes

In producer gas installations, it is necessary to use steam on the producers and there are numerous other requirements, such as cleaning down the blowing machines, heating purposes, compressing air, driving vacuum pumps (where used), and in the case where oil is used for fuel, it is necessary to keep the oil heated to a proper temperature for efficient working.

If the plant is of sufficient size, boilers of efficient water tube type, with properly designed setting, using forced draught stokers and air preheaters, should give an average efficiency of 80 per cent where coal of 11,000 to 12,000 B.t.u. can be obtained.

If fuel oil is used, combustion chambers must be carefully designed; otherwise tube renewals will be excessive and combustion inefficient.

If proper furnaces are provided, using high pressure oil burners, that is, burners in which the oil is atomized by being forced at 80/100 pounds pressure, through small apertures in the burner tip, and using preheated air for combustion, the excess air can be reduced to 15 per cent of the amount theoretically required, and, under these circumstances, overall average boiler efficiencies of 80/83 per cent are possible, if the oil has a heat value of 18,500 or more B.t.u. per pound.

It has been the writer's experience that fuel oil of appreciably lower calorific value than 18,500 B.t.u. is very viscous and high in ash, which makes it difficult to atomize and burn at sufficiently high efficiencies to obtain the average boiler efficiencies above mentioned.

To accomplish these results, pure feed water must be supplied, and as most boiler feed water contains impurities, it is well to treat the water chemically or by the use of zeolites, to remove the permanent hardness.

In connction with softening plants, it will pay to use feed water de-aerating heaters, either single or double effect, to remove the carbonic acid gases from the water, as these gases set up pitting in the boiler and are accountable for a great deal of boiler corrosion. All drips and returns from heating coils and other sources should be returned to the heater; the heat wasted through the boiler blow down can be recovered to a considerable extent; if it is discharged into the water softener, it heats the water being treated and also deposits the boiler sludge, which can, with the sludge from the softener, be discharged to the pits.

This greatly accelerates the chemical reactions and hastens the softening process.

Air compressors and vacuum pumps, if steam driven, should be compounded and operate condensing—in some cases where the exhaust steam can be used continuously for heating purposes, or for blowing the producers, it will be most economical to use engines designed to exhaust against back pressure. In this way, the heat of the exhaust is made to do useful work.

Single stage air compression is all that is required unless pressures in excess of 50 pounds per square inch are used, in which case, it will pay to use two stage compression with an inter-cooler.

The covering of steam lines is often neglected—it will always pay to cover steam lines to the most efficient point, and even pipe lines which carry hot water or other liquid should be covered, as a considerable waste of fuel takes place by this loss of heat. Where power is required at a considerable distance from the boiler plant, it will usually be found most economical to use electric motors, as the conveyance of steam over long distances involves considerable loss, due to losses through the pipes and condensation. It will generally pay to install draught gauges, CO_2, and temperature recorders for flue gases, for unless a continuous record is kept of these performances, the stokers become careless and it is extremely difficult to always check inefficiency.

However, where automatic recording appliances are used, continuous intelligent care must be given them, or they defeat the purpose for which they were installed.

A word will not be out of place on the question of cleaning boilers. It is no uncommon thing to encounter scale of ⅛ inch to 1 inch thick in the tubes of water tube boilers, and great banks of scale between the fire tubes of fire tube boilers. There will always be a big loss in efficiency where this is allowed to occur.

The same argument holds good with regard to the cleaning of combustion chambers, the outside of the boiler tubes, and, in fact, anywhere that accumulations of dust take

place; in some cases it may pay to put in mechanical flue blowers, the modern type of which are proving very efficient.

Where boiler walls are built of brick, there is generally a considerable infiltration of air through the walls, partly due to cracks which take place from expansion, and partly due to the porosity of the bricks themselves.

It is a good policy to paint the walls with some material which will resist the heat and will close the pores of the bricks, as this will stop the infiltration of air through the brick work.

In water tube boilers, great care should be given to the inspection of baffle walls. Frequently a misplaced brick will allow the gases to short circuit the heating surface. This will affect not only the efficiency, but also the capacity of the boiler.

There are so many places in the boiler house where losses can take place that more and better supervision is usually required than in the engine room, where losses can be more easily checked and seen.

It frequently requires considerable ingenuity to find points where losses are taking place, and those responsible must always be on the watch and take nothing for granted. The staff should always be on the lookout for losses in efficiency and it is necessary to make periodical tests of the plant to know that efficiency is being maintained.

In the foregoing it must be kept in mind that in designing a plant, all the factors entering into the manufacturing scheme must be carefully considered, so that the type of equipment which is purchased will be the most efficient to meet the needs. If this is done, there is no reason why average efficiencies above outlined cannot be made.

Selection of Fuel

Whether for gas-making or steam-raising, the first consideration to take into account when selecting fuel is the purpose to which it is to be applied, and the nature of the appliances in which the coal is to be used.

The second consideration in the evaluation of fuel is laboratory tests for approximate analysis and calorific value. Usually from these tests sufficient data is obtained, from which the gross heat value, ash content, etc., can be estimated.

Considerable economy can be effected by carrying out in the laboratory preliminary tests of all fuels as regards approximate analysis and calorific value, the results of such determinations being applied to the price quoted, so as to arrive at the net commercial value of the coal to be used.

The Glassblowers of Murano

by Ulrich

By Courtesy of the Metropolitan Museum of Art New York

The Deterioration and Failure of Glassworks Refractories

By B. M. Pearson

(*Continued from the June number*)

TEMPERATURE and chemical solution are not the only factors causing tank block corrosion. This will be obvious if the inside of such a furnace is inspected at the end of a working run and when the furnace has been let down for repairs. The most striking thing which will be at once noticed are vertical corrugations in the blocks extending from a few inches below the height of the block corresponding to the surface level of the glass, right down to the bottom. It seems obvious that there must be considerable corrosion owing to the presence of convection currents. If the blocks are examined closely it will be noticed that a few inches below the glass level there is a very pronounced groove, about an inch in thickness, worn out of the block. This is a rather curious phenomenon, because one might logically conclude that if there is any zone of maximum corrosion, it would occur at the glass level, or as it is sometimes termed—the flux level. A plausible theory is that there is a zone on top of the metal in the furnace obeying different flow laws from the main body of glass, immediately below. Apparently the viscosity of this glass is sufficiently low to enable the law to be sensitive enough to respond to the temperature differences occurring within the tank. Thus, for instance, it is obvious that as the walls of the furnace radiate a very considerable amount of heat, the glass near the walls will be at a lower temperature than that in the centre of the furnace. Again, in the operation of the ordinary regeneration gas fired furnace, where the gas is burned on one side of the furnace, passes over the glass, to which the flames radiate part of their heat, and escapes out of the furnace through the ports on the other side, the direction of the flames being reversed at intervals, one side of the furnace will always be at a higher temperature than the other side. The difference may not be more than 30 deg. C. at say 1450 deg. C. in a furnace operated under good conditions, but in one operated inefficiently, where say, the regenerators are in a bad way, the difference may be of considerable magnitude. Again, consider the surface of the glass along one side of the furnace. There will be considerable variations in temperature proceeding along the length of the tank. Thus the glass directly below the ports will be heated the most, whilst the glass between the ports will not be heated to such a high temperature. The effect of this uneven heating alone causes considerable convection currents on the surface of the metal. The writer has been in a number of tanks in which the glass has stood, after letting down for repairs. In flint tanks especially, the convection currents have been exceedingly well demonstrated by studying the flow lines of the scum on top of the glass. The presence of a thin layer of glass on top of the metal, possessing somewhat different flowing properties from the rest of the metal is quite well appreciated practically. For instance, when a batch change is made, the difference in the glass is perceptible long before the calculated time that the change should take place, based on the deadweight capacity of the furnace, and the tonnage of glass being worked out. This indicates that there must be a considerable amount of skimming over the surface of the glass. The writer once conducted some experiments in which small amounts of compounds able to be detected analytically when present in the glass in minute amounts were placed in the batch. A suitable one was a fluoride. The results were rather astonishing as in one furnace in which the batch was calculated to pass through in about five and one-half days, the ingredient added made its first faint appearance after only one day, was strongest at the end of two and one-half days, and then died away again in effect.

Causes of Convection Currents

There are a good many schools of thought propounding theories as to the cause of the vertical convection currents at the sides of the furnace. It is fairly plausible to suppose that the convection current is a thermal effect such as occurs in water when heated. The hotter glass is less dense than the cooler metal at the sides which being heavier, sinks, and flows down the face of the block, and glass flows in from the centre of the furnace to take its place. In this manner a circulatory convection current is set up. Another theory ascribes the effect as being due to the fact that the glass at the outside of the furnace, being in intimate contact with the block, will contain more alumina than the rest of the glass, and will be denser than the rest of the glass from this cause. In this way a circulatory current will be set up as before. Still another theory is that the addition of the alumina to the glass in contact with the blocks by solution of the refractory gives rise to an alteration in the surface tension, resulting in the setting up of convection currents. Anyhow, the point cannot be settled satisfactorily except by a tedious research, but whatever the cause the effect is clearly apparent. Of course, before the effect can be overcome, the cause must be definitely found out, and prevented.

The people who pin their faith to the thermal theory claim that the serious corrosion of the block from this source can be overcome by insulating the outside of the tank block. In this way the radiation of heat from the wall of the furnace will be prevented to a very large extent, and as a consequence the cause of the thermal convection currents would be removed. Furthermore, owing to the fact that a good deal of the escape of heat from the furnace would be prevented, the lower levels of the glass would be hotter and as a consequence more of the metal in the furnace would do the melting. Therefore a lower melting temperature would be required to

obtain a given output of glass from the furnace and so the wear and tear of the blocks would not be so severe. Whether these benefits would be actually realized in practice is, however, more or less problematical, and the consequences at stake are really so serious that no glass manufacturer wishes to be the first to experiment.

The effect of the convection currents is to increase the corrosion of the block by washing away and removing the slag from the face of the block. The slag so washed away will dissolve up in the glass, and fresh parts of the block will be exposed to the further attack of the molten metal.

Furnace Cooling

A way of reducing the corrosion of the blocks which has achieved a fair amount of success is by cooling the outside of the furnace. This can be accomplished either by compressed air or by water cooling. If cooling by compressed air is resorted to, the velocity of the air should be sufficiently great to penetrate through the film of heated air surrounding the blocks. A lazy air current and slow air velocity are not able to accomplish this, and the cooling is then practically useless. The design of the vents from which the air issues should be also such that the cooling medium is distributed uniformly over the surface of the blocks—uneven cooling is bad for the refractory. Water is a better cooling medium, as it has a much higher specific heat than air. It is however a trifle difficult to apply to the surface of the blocks to give an even distribution of the cooling effect, in the manner in which it is usually applied, and also unless a fairly elaborate system of channels, gullies and run-offs is used, inconvenience is caused by the water flowing all over the place. Also the blocks seem to suffer somewhat from the application of this cooling medium. Possibly spraying atomized water such as is used in sulphuric acid chamber sprayers would mend matters considerably as the water being in a very finely divided form would be practically instantaneously converted into steam when it touched the heated face of the block, and on account of the comparatively large amount of latent heat absorbed, the cooling would be very efficient, particularly as the cooling medium would be very amenable to control in this form. So far as the writer is aware cooling by water in a finely divided form has not yet been adopted in tank furnace practice. At present most of the cooling is done by means of steam. It can be applied to the face of the block very easily, and does not appear to be liable to cause so much damage as some of the other methods of cooling.

Cooling the outside of the furnace in this manner will reduce the chemical corrosion of the block, by reducing the temperature of that part of the block in contact with the molten glass.

A distinctly modern advance in tank block practice is to use thinner blocks. This appears a little anomalous at first, as one would argue, surely the thinner block will wear out quicker than the thicker one. But a little thought will clear the air. In place of the standard twelve-inch tank block, a seven-inch block is employed for this purpose. Now the effect of the thinner block is that the distance between the cold face of the block and the relatively hot face will be so much the more reduced and consequently the temperature of the working face of the refractory will be so much reduced. If a cooling system is used in addition, this is the more efficient because its effect is transmitted the more readily to the working face of the block. The lowering of the temperature thereby of that part of the block in contact with the molten glass will reduce the rate of attack of the glass on the refractory so considerably that actually the thin block has a much longer run in the furnace than the orthodox thick one.

It is well known by practical men that the last inch or so of a tank block has almost the same run as all the previous part of the block put together. Not so many of these thin blocks have been put into service, as they are more or less an innovation, but where they have been employed they appear to have given a fairly general satisfaction.

It is of course, speaking of the corrosion of fireclay by glass in general terms, that clay, even after having been burned previously to quite a high temperature, is fairly readily soluble in glass when in a finely divided condition. Thus in old batches, clay used to be added to the found, in order to introduce iron and alumina into the melt, and no difficulty was apparently experienced in the founding, the melt being quite satisfactory. Some experiments by Davidson and Turner[1] are of interest in this connection. They deduced the facts that burnt clay was readily soluble in a soft glass batch when fairly finely crushed, and also even clay which has been baked to as high a temperature as 1450 deg. C., is readily soluble. Also they found, as was to be expected, that the rate of solution depends upon the size of the particles, that is, on the surface area exposed. In one of their experiments the clay formed as much as twenty-three per cent of the batch, and on melting in a small pot, the glass had melted and had completely dissolved the clay within the space of one hour, forming a very viscous glass, which result is to say the least of it, very striking. Of course, it should be borne in mind that in the above authors' experiments the clay was very finely divided, and intimately mixed with the glass batch. In refractories the contact is only intimate over a very limited area, and consequently the surface exposed is comparatively very small. The clay was prepared by firing biscuit portions of an unused glass pot to 1450 deg. C. approximately for as long as three days, so that it will be seen that the heat treatment given to the clay before incorporation in the glass batch was very thorough. It will be appreciated that the main facts brought out by the above work are that clay which has been fired to quite high temperatures for prolonged periods is still soluble in glass, and that the corrosion of the block will depend a good deal upon other factors, such as the surface exposed, working temperature of the furnace, and chemical composition of the glass. It does not mean to say that careful heat treatment of the blocks is not beneficial as from practical grounds alone, it undoubtedly is, but it is just as well to emphasize that merely firing tank blocks to a very high temperature does not make them absolutely insoluble in glass as is sometimes erroneously supposed. If this were so, a tank block

[1] *Journal Society Glass Technology*, Dec., 1918, p. 280.

of course ought never to wear out, if it is heat treated at a high enough temperature.

Use of Refractory Lining

Some work has been done from time to time in the direction of imposing a refractory lining highly resistant to corrosion, on the working face of the block, and also on the inside of glass pots. The idea is intrinsically good, but a difficulty occurs, owing to the fact that the physical constants of such a satisfactory lining will be different from those of the block. Thus, for one thing, the lining will have a different coefficient of expansion, and will craze and peel off. The exposed block underneath will be very ill able to withstand the glass attack, and so the lining will make matters rather worse, if anything.

The case of tank blocks has been dealt with first because these are one of the most important classes of refractories used in glassworks, both from the point of view of the extent to which they are used and the expense which is occasioned by their untimely failure when being used in position in the tank furnace.

We will pass on now to the bricks used in the crowns of tank furnaces. These used to be a highly aluminous brick but are nowadays what is termed a silica brick, which is a brick containing about 97/98 per cent of silica, with a little lime, used in the manufacture of the brick, to bond the silica. Silica bricks suffer very considerably from spalling, and where this is excessive the brick may entirely disintegrate. Silica bricks should have a fairly good crushing strength as the arch is invariably sprung, rather than suspended, and the brick therefore have to resist the side thrust resulting from their own weight. On account of the silica of which the brick is principally composed existing in several forms having widely different specific gravities, the change from one form to another being a temperature function, great care has to be taken in bringing up a furnace that the transformation from one form to another does not take place too quickly. If this happens cracks will occur between the crystal facets and may possibly extend sufficiently into the structure of the brick itself to weaken this. The expansion of the bricks is also large, and so this factor has also to be guarded against when bringing up the furnace, by letting out the tie-rods accordingly.

The wear of the bricks in the crown may take place owing to two distinct and separate causes. The first and not so very important one is due to the cutting action of the flame, and the abrasive action of the dust mechanically carried through the furnace in the action. The most important corrosive agent is, however, once again, chemical action. Although the silica bricks do not come into direct contact with the glass itself, yet a considerable amount of corrosion occurs at the working temperature of the tank furnace. Sodium oxide is fairly volatile, and the furnace atmosphere is therefore saturated with this constituent. The sodium oxide vapor coming into contact with the crown, which will be unsaturated with soda will react, forming a more or less impure sodium silicate. Being quite fusible at the high temperature to which the under part of the crown is exposed, this compound will after a while, collect into a drop sufficiently large enough to fall off into the molten glass below, where it will dissolve up. A typical analysis of such a furnace drop is the following: SiO_2 53 per cent; Al_2O_3 30 per cent; Fe_2O_3 2.5 per cent; CaO 1.5 per cent; TiO_2 1.0 per cent; Na_2O 12.0 per cent.

The amount of soda in this drop will depend upon the composition of the glass being worked. Thus the more soda there is in the glass, or in other words the softer the glass is, the more soda there will be in the furnace atmosphere when it is in equilibrium with the glass. As a result the more soda will there be in the crown drop when it is in equilibrium with the furnace atmosphere and on the point of dropping off. The more soda there is in the drop, the more fusible it will be of course at any given temperature, than one containing less soda, and so the sooner will it drop off into the glass, thereby exposing more quickly fresh parts of the crown to the attack of the alkaline vapor. Thus a soft glass is more severe on both the blocks and the crown than a hard glass containing less alkali. Of course, corrosion from this cause is not so rapid as it might well be, as when an alkaline vapor attacks the surface at a high enough temperature to form a glaze, any pores and fissures are soon closed up, and the fluxing action is then comparatively slow. Professor Cobb has a word to say about this.[2] In his words, "if a mixture is made up, corresponding say to cone 4, and that mixture is applied to a vertical surface and fired, it will not begin to trickle down even at cone 9. It would stand almost indefinitely on a vertical surface at a temperature of more than 100 deg. above that at which it fused as a cone, and for that reason the fluxing away of a brick under these conditions by trickling down, is comparatively slow." Of course it must be borne in mind that the crown is one of the hottest portions of a tank furnace, and that at the temperatures ruling in this part, the compound formed by the interaction of the alkaline vapor with the brick is not so very viscous, so that surface tension can come into play. The texture of the brick will play a fair part in deciding the rapidity of corrosion; with a coarse texture, and therefore a relatively small surface exposed to the attack, the corrosion will not proceed so rapidly as it would do with a finer texture and a greater surface area exposed.

The subject of glass pots is rather a vexed problem, as this class of glassworks refractory is not as a general rule noted a great deal for its long life. Indeed inquests on the premature death of a glass pot are more frequent than perhaps they really should be. Two types of glass are most generally melted in pots—lead glass and soda-lime glass. In addition small amounts of optical glass and chemical resistance glass are made in pots. Optical glass is not particularly severe on the refractory in which it is melted, as the melting requirements on the whole are not specially severe. Chemical resistance glass is a very hard glass, whose composition is designed with an eye to inducing resistance against the action of corrosive agents, such as water, acid, and alkali. As a consequence, its melting temperature will be rather exactingly high on the pots, and the life of these will be on this account so much the shorter. Lead glass is

[2] *Jour. Soc. Glass Tech.*, Dec., 1918, p. 262.

very corrosive to glass pots, and such refractories rapidly deteriorate when employed in founding this metal. Being rich in bases, and relatively low in silica, compared with the normal glass composition, it readily dissolves the pot material up, and absorbs the silica to effect a better balance in its chemical composition and a more stable equilibrium. This tendency is reflected in the very attenuated life of the pots when melting this metal. The attack of the soda-lime glass on the pot will be similar, but somewhat more active on the pot than is the case with the action of the same glass on the tank block. Thus a glass pot is set right inside the furnace, and is exposed on all sides to the full effect of the temperature. No cooling of the working face can be effected, as is done in the case of the tank block, and anyway, under normal working conditions, and even when no cooling is resorted to one face of the block is naturally very much cooler than the working face, and so helps also to bring the temperature down of that side of the block in contact with the glass. The corrosion of the glass proceeds more rapidly in the pot from this cause. In the case of covered pots, definite corrosion takes place in the crown, by the fluxing action of the alkaline vapors given off by the glass and batch, and which are present in the atmosphere of the pot. The action is precisely the same as occurs in the case of the attack on the crown of a tank furnace with the exception that in the pot attack, a fireclay material is corroded, whereas in a tank furnace crown it is practically pure silica which is attacked. Under the heading of chemical attack, and corrosion, can also be included the distressing phenomenon termed "shot-holing." Shot-holing occurs often in the bottom of the pot and more generally at the angle of the junction of the side with the bottom. The action of the attack is rather peculiar and not a little mystifying, as vertical holes of tunnels from one quarter to one half inch in diameter are drilled right through the pot. The symptoms first start by a small hollow being produced, and this rapidly extends until the bottom of the pot is pierced right through. The action is extremely rapid and may take only a week or so to complete upon which of course the pot is ruined and useless. Failure from this cause is particularly vexing, because the pot may actually still have a great many potential weeks of useful working life, when it is put out of commission for this reason. The trouble is obviously started by the presence in the bottom of the pot of easily corrodible material, which dissolving up, allows cavities and incipient holes to be formed, and the theory is then that convection currents in the glass within the partly formed drill complete the corrosion right through the pot bottom. Specks of iron pyrites in the clay material are a fruitful cause of the starting point for the formation of such cavities and the drilling of the pots.

Hyslop[2] concludes that the results obtained from glass pots, noted in service, are closely related to the grog and matrix, and of these two factors the matrix is the principal one in determining the rate of attack of a pot. Further it is shown that in order to form a highly desirable protective layer, it is necessary to have a high alumina content in the clay. If the fired clay has a high percentage of mullite, it will tend to form with the glass an intermediate layer of high viscosity. This prevents rapid chemical action, and the mullite in the layer is protected, since it is embedded in a viscous, highly siliceous glass. In the case of a composite refractory such as a pot, the evidence strongly suggests that a high mullite content is essential in the matrix of the body. That is, if two pots have the same percentage of the same grog, then the one with the higher mullite content in the matrix will be superior in resisting corrosion.

(To be continued)

[2] *Jour. Soc. of Glass Tech.*, June, 1926.

Development of the Thermometer Industry of Thuringia

By DR. H. FISCHER, ILMENAU*

The thermometer industry is a branch of the lampworking industry of Thuringia, which developed about the end of the 18th century. It owes its existence to the still older glass manufacturing industry of the region, which succeeded in producing a glass especially adapted to lamp working, due to the alumina content of the sand used, which prevents devitrification during the period of softening of the glass. The city of Lauscha must be considered the birthplace of the industry, a city famous for its manufacture of glass beads and glass jewelry. From there it spread to Stützenbach. It can be stated with considerable certainty that in that city of Thuringia thermometers were first made on a factory scale. A glassmaker named Berkes from Neuszis had made there the first thermometers, which were soon imitated, much against his wishes. The year 1830 marks the beginning of the thermometer industry of Thuringia. In the historical and geographical description by Henneberg, the firm of F. F. Greiner of Stützerbach is mentioned which, besides other glassware, made 64 different varieties of hydrometers and thermometers. After the death of F. F. Greiner in 1855 a number of his employes went in business for themselves and established firms which occupy important places in the thermometer industry of the present day.

The manufacture of thermometers at that time was highly developed as regards manual skill, but the equipment as compared with modern appliances, was primitive. This applies to glass-blowing lamps and to auxiliary equipment, and also to the glass itself.

The potash-soda-lime glass, which had been used up to the year 1850 was first replaced by a pure soda-lime glass by the firm of Friedrichs without realization on the part of the originators of the principal advantages of this change, namely, the small thermal afterchange of the glass. Later, glass containing both alkalies was made again, and the lowering in quality caused thereby became one of the main reasons for the beginning of the systematic research under the auspices of the Imperial Standards Committee, in connection with the laboratory of glass technology of Jena. The result of this study was a recognition of the fact that glasses which contain only one alkaline constituent give a thermometer glass having only a small depression of the zero point and subsequent rise of the latter. The firm of Schott & Gen. of Jena, since the year 1885 has made so called normal glass,

* Abstract of paper read at Weimar meeting of German Society of Glass Technology.

known as 16^{III}. At the request of the government the firm of Greiner and Friedrichs, Stützerbach, commenced making this kind of glass in 1886. Since 1914 it is also being made by the Glassworks Gustav Fischer, and since 1926 by the Glassworks Sophienhütte, Ilmenau.

The production of high grade thermometers became possible through the making of a series of special glasses, made by the Jena Glass Works.

Besides these improvements in the manufacture of thermometers as regards the purely technological aspect, many important changes were effected in the shape of the thermometers. Both kinds of improvements were the result of advances made in science and its practical application, which steadily enlarged the field of their use. In the place of the clumsy and fragile thermometer with only the scale enclosed, we now have the modern form, enclosing both the scale and the capillary tube, containing the mercury column. Since the year 1860 clinical thermometers have been manufactured in various forms. The year 1870 marks the beginning of the manufacture of the so called English prismatic clinical thermometer.

In the year 1889 the State established an institution for the testing of thermometers. The specifications have been drawn closer and closer, in order to raise the standards of the Thuringia thermometer industry, and to keep abreast of foreign developments of the industry. The testing of clinical thermometers has become obligatory since 1921.

The increased number of thermometers produced annually gives hope for the future favorable development of the thermometer industry of Thuringia.

Glasses for Protection Against Harmful Rays

By H. Meesz*

Through the increasing knowledge concerning the physiological action of light rays, especially the invisible rays of the spectrum, the glass industry is confronted with a new and difficult, but also exceedingly interesting problem. A demand has grown up for protective glasses, especially eye glasses, which will shield the eyes from strong light, ultra-violet rays, etc. The conviction that infra-red rays have a harmful effect is becoming more and more general. For this reason it has become desirable to produce glasses which afford protection against ultra-violet as well as infra-red rays. It is of interest to note that ultra-violet rays have a deleterious effect on certain valuable substances, for instance natural silk, so that exhibiting of such materials under the protection of ultra-violet absorbing glasses would appear to be desirable.

On the other hand, there is a demand for glasses which will transmit ultra-violet rays, for instance from hospital authorities.

With regard to these properties, glasses may be grouped as follows:

A. Glasses which absorb ultra-violet rays.

B. Glasses which absorb both ultra-violet and infra-red rays.

C. Welding glasses.

D. Protective glasses, used for the observation of furnaces.

E. Glasses which transmit ultra-violet rays.

F. Glasses which absorb X-rays.

It is well known that ordinary window glass absorbs a considerable part of the ultra-violet rays. However, window glass is by no means a complete protection against such rays. Ophtasan glasses, made by the German Plate Glass Corporation at Grünenplan, which can be obtained in many degrees of permeability and color afford complete protection against ultra-violet radiations.

Type A-I, for instance is scarcely colored. It shows only a faint bluish tinge. The rays of the visible spectrum are almost completely allowed to pass through the glass, and the light intensity, for all practical purposes, is not diminished. Glass having a thickness of 2 millimeters will absorb all rays having a wave length of less than 355$\mu\mu$ so that the eyes are completely protected against ultra-violet rays. Of a similar action is Ophtasan glass A-II, which is only a little darker in color, and which for this reason can be considered to be of some protection against glare. Glass B-I has a pleasing grey color and in addition to being opaque to rays of short wave length, it affords protection against glare. Glass B-II is used for the manufacture of eye glasses which protect against sunlight. Glass B-III is used especially for protection against strong artificial light.

Glasses are made in different colors, to suit the individual tastes of the consumers. For instance "Ultrasin" glass, which absorbs light rays of a wave length of less than 360$\mu\mu$ has a light reddish color, which appears to be agreeable to many people. This glass has become popular in a very short time. An almost entirely colorless glass, known as "Nilvi" glass, which absorbs rays of less than 355$\mu\mu$ is becoming quite popular in England.

Of interest also is the "Luminal" glass, which absorbs rays of less than 470 $\mu\mu$ and for this reason is more effective than anyone of the glasses mentioned above. It has a light yellow color, very pleasing to the eye.

The German Plate Glass Corporation has produced two protective glasses which are opaque to infra-red rays. The "Iro" glass, of a light green color, absorbs rays of a wave length less than 345$\mu\mu$. In this respect, therefore, it is less efficacious than the Ophtasan glasses. However, it also absorbs considerable of the infra-red rays. This property was determined by the method of Conrad.[1] The reading of a radiation pyrometer, directed onto a hot furnace amounted to 1400 degrees C. without a protective glass. The use of a 2 millimeter thickness of "Iro" glass decreased the temperature to 1140 degres C. In this way the harmful rays, located on both sides of the visible spectrum are removed, without decreasing the light intensity of the visible range. Besides being suitable for eye glasses, this glass should be valuable for

*Abstract of article published in *"Die Glashütte,"* Vol. 57, No. 17. 325-328 (April, 1927).

use in the tropics for glazing purposes, as it filters out the heat rays.

Of similar, but much stronger action is the yellowish green glass 422-I, obtainable in three grades. The glass of the darkest color absorbs short wave rays up to 460$\mu\mu$ completely. The radiation pyrometer, by the use of this glass, fell from 1440 degrees C. to almost zero. This glass may be considered an ideal protective glass.

Some glasses, having similar properties are especially used for welding purposes. Such glasses are No. 6 and 368-I. Both glasses completely eliminate ultra-violet radiations. Glass No. 6 absorbs rays of a wave length up to 405$\mu\mu$. Its color does not make it suitable for every kind of welding work. A darker glass for welding purposes absorbs light rays up to 550$\mu\mu$. This glass can be made in an even darker shade, and with the development of these glasses, the whole range for welding purposes is covered.

Glasses used for the observation of melting furnaces require similar properties. Besides absorption of the invisible rays, protection against glare, even from white hot furnaces, is desired. Not every color is suitable for this purpose. Blue glasses appear to be the best. Up to the present time, however, no glass was known which combined the properties of being suitable for observation of furnaces, and at the same time to absorb ultra-violet and infra-red radiations. Such glasses are now available. For instance "UVA" glass, which is suitable for furnace work, is also opaque to ultra-violet rays. With regard to infra-red rays, however, this glass is less effective. A nearly ideal glass of this type is known as 52-I. It has a dark blue color, which makes it especially desirable as a protection against glare, yet it allows sufficient light to pass to make it suitable for furnace work. In a thickness of 2 millimeters, it prevents the passage of rays up to 365$\mu\mu$. The temperature reading of the radiation pyrometer went down from 1440 degrees C. to about 200 degrees, through the interposition of this glass. The infra-red rays are completely eliminated. This glass may be considered as unsurpassed for the purpose for which it is intended.

So far, only glasses have been considered which afford protection against harmful rays. Mention must be made also of glasses having exactly opposite properties. Although harmful to the eye, ultra-violet radiations have valuable curative properties. Until recently, rest rooms of hospitals for the tubercular could not be protected with glass, as this would intercept the curative properties of sunlight, especially the ultra-violet rays. The "Brephos" glass fills this want. It is almost colorless. In a thickness of 2 millimeters it still transmits rays of 288$\mu\mu$ wave length whereas window glass absorbs rays of less than 315$\mu\mu$.

Similar properties has the blue "Brephos" glass, used primarily in connection with the quartz lamp, for analytical and other scientific purposes. As is known, ultra-violet rays cause fluorescence, which makes it possible to recognize differences in the inner structure of various materials. They are also valuable for detective work, for instance for the detection of falsification of paper currency.

A special group of glasses deserves mention, they are the glasses which protect against X-rays. Formerly lead plates were used for this purpose, which, however, prevent observation. The German Plate Glass Corporation has succeeded in making glasses which through their high lead content are almost as effective as lead plates. The type R-40 contains 40 per cent lead oxide. The "lead equivalence" has been determined, and was found to be 12 per cent. A glass of 10 millimeter thickness would have the same protective action as a lead plate of 1.2 millimeter thickness. These glasses are made in various sizes (4-5, 8-10, 18-20 mm. thickness). Even stronger protection is afforded by glasses R-51 and R-65, having a lead oxide content of 51 and 65 per cent respectively. Their "lead equivalence" amounts to 18 and 25 per cent.

[1] *Zentralzeitung für Optik und Mechanik*, 46, 215-216, 1925.

Novel Method of Making Laboratory Glassware

In an article, "Health Hazards of the Glass Industry," published in the annual report for 1926 of the Industrial Commissioner of the State of New York, and reviewed elsewhere in this issue, reference is made by an observer to an unusual process for manufacturing a special kind of laboratory glassware, of which the following description is given:

"This ware is made entirely of pure silica sand. When finished it is smooth and translucent and something like mother-of-pearl in color. It is almost fireproof, will stand 400° to 1,200° F. without change and is acid proof, except for hydrofluoric acid. This glass is used for electric insulation, for acid conveyors and condensing pumps. Mixing and fusing are done in a small building in the rear yard of the factory building and no gas is used.

"The quantity of sand desired is shoveled into a pile on the floor, and a stick of pure graphite is placed in the middle of the small mound thus made. The graphite is heated by electricity until it is red hot and fuses all the sand around it into glass. The graphite is lifted out of the sand mold after a short time, and the fused material pulled out with large pincers and drawn into long tubes or pipes, which can be cut into the desired lengths. When forms for jars or other vessels are wanted, the sand is placed in an iron mold before the graphite stick is put in.

"The glass tubes and forms are very rough when cool, and have to be cut and smoothed on emery wheels. This is a dusty and dangerous operation, but an exhaust system is provided. Final shaping and tempering of this glass is done in an electric furnace by hydrogen-oxygen torches. The light and heat from this operation are intense, and the workman wears a helmet with orange-colored glass for eye protection. The process is interesting in that it is so entirely different from the ordinary methods of glass making."

THE BUREAU OF STANDARDS in *Technical News Bulletin*, No. 123, in answer to requests for inexpensive thermal expansion equipment, describes a type which has been used in European laboratories for a number of years. Slight modifications have been made by the bureau. A fused quartz tube about 50 cm long and 2 cm in diameter is closed at one end. The specimen to be tested should be about 20 cm long and is placed in the tube. On top of the specimen is placed a fused quartz rod sufficiently long to reach to the open end of the tube. An indicator gauge is fastened to the top of the tube and registers the relative motion between the tube containing the specimen and rod resting on the specimen. The bottoms of the tube and rod are ground concave and the ends of the specimen convex to secure satisfactory contacts. Heating is effected by placing the tube and sample in a water or oil bath or electrical furnace extending well above the top of the specimen. Low temperatures are secured by using proper cooling baths. A thermocouple placed inside the fused quartz tube near the sample indicates the temperature. The average coefficient of expansion of fused quartz (0.0000005 per degree C.) should be added to the expansivity coefficient secured from this equipment.

THE FUELS DIVISION of the American Society of Mechanical Engineers announces a meeting of exceptional importance to all interested in the use and conservation of fuels, to be held at St. Louis, Mo., October 10-13, 1927. There will be a program of papers by recognized authorities on appropriate subjects.

The Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

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THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

CONTRIBUTIONS

THE EDITOR welcomes practical articles on all subjects related to GLASS MANUFACTURING. Such articles, if accepted, will be paid for at our usual rates.

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Two Books on Glass Making

Books of lasting value interpret the thoughts of many. They are the reflection of ideas that occupy not a few isolated thinkers, but that have general appeal. Two books indicative of the modern trend of thought on glass manufacturing have recently appeared in England. They are "Defects in Glass," by C. J. Peddle, and "The Constitution of Glass," the latter a series of articles, reprinted from the *Journal of the Society of Glass Technology*, collected by W. E. S. Turner, Secretary of the Society.

The publication of these books at this time is significant. They encourage the hope of a satisfactory solution of problems, generally recognized as factors limiting further development of the glass manufacturing industry of the present day.

The mechanical development of the glass industry since 1900 has been phenomenal. It would be difficult to find greater mechanical efficiency in any other industry. But the view is held by many who have given serious thought to the subject that further important improvement of the engineering phase of the glass industry is directly dependent on a fuller understanding of the nature and constitution of glass. What we need to know, and what we do know about these questions is presented in these two books in an authoritative manner.

"Defects in Glass" discusses the various glass troubles which the glass maker encounters daily in the factory. For this reason it will make a strong appeal to the men in the production end of the industry. "The Constitution of Glass" will interest primarily the scientific worker. Yet to the practical man these papers are of no less importance, for on scientific conceptions of the nature of glass will depend the solution of the majority of practical problems with which the glass industry is confronted.

The two books complement each other in a remarkable way, and their publication at the same time is especially fortunate. A study of both will aid to broaden one's outlook on the present status of the practical and theoretical bases of glass manufacturing.

The papers composing "The Constitution of Glass" have been contributed by leading scientists of glass producing countries. England is represented by Bragg, Stott, Turner and Rosenhain; France by Le Chatelier; Germany by Eckert and Tammann; the United States by Bowen, Hill, Morey, Tool and Wyckoff. The fact that men of such standing in the scientific world are taking hold of these problems gives hope of their ultimate solution.

A study of the books will impress the reader with the conviction that much remains to be done in the way of research on the nature and constitution of glass; that we have as yet insufficient knowledge as to the causes and prevention of devitrification and of the mechanical properties of glass, to mention only two of the most burning questions of the day.

No real improvement could have been made in lehr construction and in glass annealing, until the nature of the annealing process had been thoroughly explored. In a similar way, we cannot hope for much further progress in

mechanical glass making until the mysteries of the nature of glass are better understood.

Even when this has been accomplished, there will still remain the need for those who can take the part of the *liaison* officer in modern warfare, who can interpret the needs of the practical glass maker, the glass scientist and the glass engineer and who are able to effect the necessary cooperation between them. Many times the glass scientist has felt that he might be able to produce much needed results if the glass engineer and the glass maker could definitely formulate what is wanted. While there exists unity of purpose, the professions whose cooperation is required for success do not always speak in terms mutually understood.

A study of these two books will be an aid in bringing forth a better understanding between the branches of modern glass manufacturing, so essential to further progress.

Health Hazards of the Glass Industry

In the annual report of the Industrial Commissioner, James A. Hamilton, of the State of New York, for the year ended June 30, 1926, a report is published on the results of a survey of the glass industry of the State undertaken by the Department of Labor to determine the health hazards involved in glass-working operations. The survey was made under the supervision of Dr. Leland E. Cofer, Director of the Bureau of Industrial Hygiene, in connection with two larger investigations now under way in the same industry into lead poisoning and silicosis. The report was prepared by Minnie M. McMahon, of the Bureau staff.

The report calls attention to the following statement by John H. Vogt, of the State Labor Department: "There has been little or no experimenting along the line of health protection among glass grinders, wherein lies a field for the ingenious engineer to afford better health protection than is now afforded."

The study covered the inspection of 120 factories employing over 5,000 persons. Following are short abstracts from the report, which describes the working operations briefly, points out the dangers involved and suggests protective measures to be taken.

Forty-three factories doing grinding, beveling and polishing of mirrors, automobile glass, table tops, glass signs, optical and other lenses were visited. Silvering and backing of mirrors, ventilation of silvering rooms, resilvering and renovating are briefly discussed, also beveling, lens grinding and polishing of plate and automobile glass. In all the mirror factories visited only five women were found in silvering rooms, and nine at polishing and grinding. In thirty factories where glass grinding was done, general sanitary conditions were good, fair in seven and very poor in eight.

Dry grinding of glass on emery wheels or sanders is a very dusty operation. Analysis shows that flint used in making sandpaper contains over 97 per cent of silica. Mixed with the glass dust, which also contains a high percentage of silica and sometimes arsenic or lead, it forms a most injurious dust.

Lead poisoning was a very common occurrence in cut-glass factories in former days, but the decrease in the use of putty powder and the adoption of the hydrofluoric acid method has materially changed conditions. The necessity is emphasized, however, of taking precautions to protect the worker from acid fumes and burns, not only in the chemical polishing process but also in the etching department. Safety suggestions are made.

An investigation showed that the silicosis hazard in the sand-blasting process comes from the fine dust caused by the breakdown of the sand particles from use.

In the glass-decorating shops, the principal hazards are lead poisoning, resulting from the extensive use of lead, and fumes and burns caused by the use of hydrofluoric acid.

In stained-glass shops, lead poisoning sometimes results from handling strip lead, used for joining the numerous small parts of windows, and the use of other lead products, such as litharge and red and white lead contained in cement and putty. Carbon monoxide poisoning from the large quantities of gas burned in kilns and for heating soldering stoves is possible in poorly ventilated rooms.

In bent-glass shops, lead solder and lead pots are used and this constitutes a source of lead poisoning. Acid fumes and burns are also prevalent. An investigation into glazing conditions, indoors and out, indicated that lead poisoning was not prevalent.

In the making of glass pots the principal health hazard is dust associated with the handling of clay and the grinding of the "grog."

In the making of glass from raw materials there are hazards encountered in some factories that have been practically eliminated from others, such as the poisonous and irritating dust resulting from hand-feeding of batch materials, which method has not been superseded by automatic or semi-automatic methods such as used in some plants. There is a vast field for engineering skill in solving the peculiar dust problems of the glass industry to which the ordinary exhaust methods cannot be applied.

Dust from the batches, especially in soda glass, adhering to the skin from perspiration causes eczema and other irritating rashes of which the so-called "batch poison" or "batch disease" is an example.

The glare from the furnaces into which the worker must look causes eyestrain and sometimes cataract. Dr. George M. Kober in "Industrial Health" quotes statistics (Meyhoffer) showing that out of 506 glass blowers examined in Germany 59 had cataract and of these 42 were under 40 years of age. It is shown also by these statistics that change in the lens of the eye among glass blowers between 30 and 40 are five times greater than among people in general, twice as frequent in those between 40 and 50 and three times as frequent in those over 50. "These changes vary from a general dullness or opacity to fully developed cataract."

In one of the larger laboratory-glass plants visited the test tubes and vials are marked with measuring scales. This is done both by sand blast and hydrofluoric acid. Two girls in this plant do the marking of the test tubes for the etchers. They are given a set of measuring tubes and an exact quantity of mercury. The mercury is poured into the tube to be marked and a line drawn where it ends. The girls pour the mercury back and forth from one tube to another very rapidly. It is rarely spilled, nor does it seem to touch the hands.

In the making of laminated glass, used for windshields, signs, etc., there are no special health hazards, except the inhalation of fumes where large quantities of amyl acetate are used in the cementing process.

Accident Statistics

The accident rate for the glass industry in New York State for 1922-1923 was 30 per 1,000 employees. This includes only compensated accidents and takes no account of less serious ones. As the average for all industries is 20 per 1,000, it will be seen that the glass industry rate is high. In fact it stands about seventh in accident frequency among all the industries of the State as they are grouped for tabulation (19 groups).

One hundred and seven-seven compensated accidents were listed for this period. Among the causes given are: 7 burns from hot glass, 38 from handling glass and 25 from machinery.

A study of the case histories of about 50 compensated accidents in the glass industry during the years 1924-1925 shows that cuts and scratches still stand out as the principal accident hazards.

The text of the article here reviewed fills 42 pages out of 486 in the Annual Report for 1926 of the Industrial Commissioner of the State of New York, and there are also eight pages of illustrations of interiors of glass-working plants of various types.

New Books

THE CONSTITUTION OF GLASS, A Series of Papers Reprinted from the *Journal of the Society of Glass Technology*. Edited by W. E. S. Turner, O. B. E., D. Sc., M. Sc., F. Inst. P. Published by The Society of Glass Technology, Darnall Road, Sheffield, England. Size 5½x8¾ inches, VII and 186 pages. Bound in cloth. Price 7 shillings, 6 pence.

Eight of the papers formed part of a symposium on the constitution and nature of glass, held in May 1925. Papers by V. H. Stott in 1926 and one by W. Rosenhain in 1927 have been added. These papers will give to the reader a clear understanding of present day conceptions of the glassy state, written by men who are unquestionably authorities on this difficult subject.

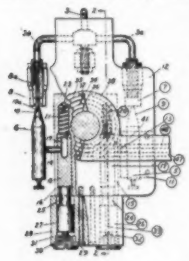
EXPERIMENTAL RESEARCHES AND REPORTS, published by the Department of Glass Technology, The University, Sheffield, Vol. IX, 1926. Collected from *Journal of the Society of Glass Technology*, Reports of the Progress of Applied Chemistry, *Journal of the Chemical Society* and *Journal of the American Ceramic Society*. This volume contains a number of papers on glass which have appeared in the publications mentioned above.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington D. C. Price 10c each

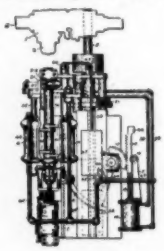
GLASS FORMING APPARATUS. U. S. 1,632,963. June 21, 1927. Orin A. Hanford, deceased, Columbus, O., by Andrew J. Schlereth, administrator, assignor to The Federal Glass Co. Filed 3/31/24. Means for introducing fluid to glass blanks comprising a conduit leading to the blank retaining head, a normally closed valve in said conduit, a nozzle through which fluid is passing continuously and pneumatic means for intermittently moving said nozzle into co-operative relation to said conduit. The aim is the provision of an entirely novel method of supplying the air to the glass blank which eliminates all possibility of oil or water marks being formed in the ware and which automatically controls the introduction of the air to the blank under all conditions.



GLASS FEEDER. U. S. 1,631,230. June 7, 1927. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 3/26/24. The discharge regulator is preferably in the form of an inverted cup or bell of larger diameter than the outlet thereby providing a capacity device or chamber by which it is claimed, a certain amount of glass is segregated from the surrounding body of glass and so confined that the movement of the glass through the outlet is effectively controlled.

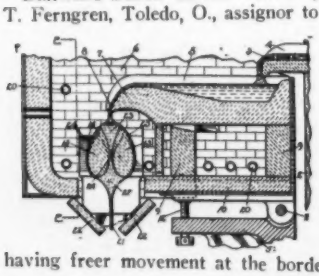
FURNACE FOR MELTING AND REFINING GLASS AND OTHER LIKE PURPOSES. U. S. 1,636,151. John Schofield Shaw, Leeds, England. Filed 6/16/24.

METHOD OF COOLING MOLDS. U. S. 1,632,962. June 21, 1927. Orin A. Hanford, deceased, Columbus, O., by Andrew J. Schlereth, administrator, Columbus, O., assignor to The Federal Glass Co. Filed 3/31/24. The method of cooling blow molds in the making of glassware which comprises lowering the mold from blowing to inoperative position, spraying the mold with a cooling fluid and raising the mold to blowing position to stop the spraying action. The invention contemplates the elimination of all dirt and oil in the cooling of mold parts by raising and lowering and opening and closing the mold parts to intermittently effect the blowing of the glass blank and automatically spraying the mold parts with a fresh cooling liquid when lowered from blowing position.



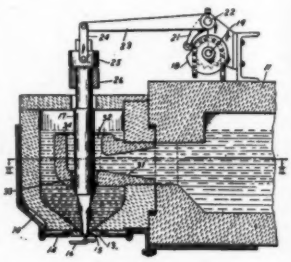
GLASS COMPOSITION. U. S. 1,629,648. May 24, 1928. Warren F. Bleecker, Boulder, Colo. Filed 7/22/22. A transparent, henna colored lead glass resulting from a composition consisting of sand 75 parts, soda ash 80 parts, litharge 70 parts, borax 20 parts, nitre 30 parts, and uranium oxide from 4 to 24 parts, also a glass same as above with addition of manganese dioxide from ½ to 4 parts.

DRAWING SHEET GLASS. U. S. 1,631,805. June 7, 1927. Enoch T. Ferngren, Toledo, O., assignor to the Libby-Owens Sheet Glass Co. Filed 5/15/24. The process of producing sheet glass, consisting in intercepting a downwardly moving stream of molten glass, and causing the glass to flow through a suitable passage which is relatively more restricted at the center than at the ends thereof to produce a uniform sheet of glass, the glass having freer movement at the border portions than at the center.



APPARATUS FOR CONTROLLING THE FLOW OF MOLTEN GLASS THROUGH A DISCHARGE APERTURE. U. S. 1,631,061. May 31, 1927. Carl Henry Rankin, Wellsburg, W. Va. Filed 11/29/26. In apparatus for controlling the flow of molten glass through a discharge aperture, the combination of a plunger arranged in axial alignment with the said aperture, a sleeve surrounding and spaced apart from the said plunger, and corrugations on the interior wall of the said sleeve.

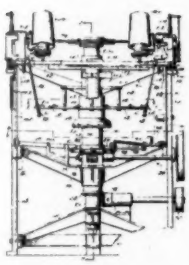
APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,633,044. June 21, 1927. Leonard D. Soubier, Toledo, O., assignor to The Owens Bottle Co. Filed 4/14/24. The combination of a container for the glass having an outlet opening in its bottom, a regulating member projecting downward into the glass over the outlet and controlling the discharge, said container having an inlet opening below the normal level of the glass, means for supplying glass to the container through the inlet opening, and means to distribute the entering glass around the regulating member and then cause the distributed glass to move outwardly away from the regulating member before it reaches the said outlet opening.



MACHINE FOR FORMING GLASS ARTICLES. U. S. 1,636,672. July 19, 1927. Richard La France, Toledo, O., assignor to The Owens Bottle Co. Filed 11/2/25. In a machine for forming glass articles, the combination of a rotating mold carriage comprising a plurality of units, and compound suction gathering molds in each unit disposed in different planes, substantially as described.

FEEDING MOLTEN GLASS. U. S. 1,631,107. May 31, 1927. Karl E. Peiler, West Hartford, Conn. Filed 1/28/26. Filed for the purpose of claiming certain features disclosed in the original application (filed May 5, 1919, Serial No. 294,792), particularly the control of the shape of mold charges of molten glass.

GLASS-GRINDING MACHINE. U. S. 1,635,491. July 12, 1927. John A. Milliken, Ambler, Pa., Assignor to John E. Marsden. Filed 11/1/22. Mechanism for automatically effecting changes in the relative positions of the glass article being ground and the cutting tool, so that various portions of the glass article may be automatically presented to the grinding wheel in a predetermined sequence. In order that the surfaces between the said spaced points may not be marred, means are provided for moving the holder and the article carried thereby radially out of engagement with the grinding disc, while the individual rotative movement is being imparted thereto.

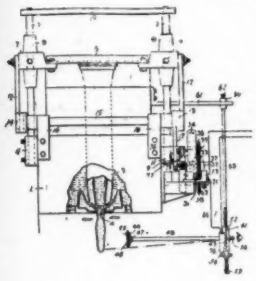


DRAW TABLE RAIL. U. S. 1,634,827. July 5, 1927. John L. Drake, Toledo, O. Assignor to the Libbey-Owens Sheet Glass Co. Filed 10/13/24. A flexible link belt formed from a plurality of links having a curved under-surface, of a draw-table rail having curved ends, the radius of the curved ends being the same as the radius of the curved under-surface of said links.

COLORLESS CROOKES GLASS. U. S. 1,634,182. June 28, 1927. Philip Victor Willingham Gell, Charles Edwin Gould, Wilfred Marsh Hampton and Harold Sharpe Martin, Smethwick, England, assignors to Chance Brothers & Co., Ltd. Filed 5/11/25. A glass for use in lenses, said glass containing approximately

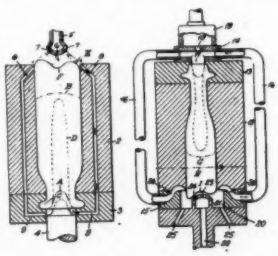
3.3% of cerium to partially absorb the ultra-violet rays and approximately .7% of didymium to assist in the absorption of such rays and to neutralize the color that would be imparted to the glass by the cerium and with the cerium to absorb practically all the ultra-violet rays.

REGULATING GLASS FEEDERS. U. S. 1,636,564. July 19, 1927. George E. Howard, Butler, Pa., assignor to Hartford-Empire Co. Filed 3/8/24: The combination with means for feeding gathers of glass, of apparatus for determining the character of said gathers comprising a gauge device past which said gathers are fed, an aperture through which said gauge device and gathers may be viewed, a shutter, and means intermittently actuated by the feeding means for actuating said shutter to alternately open and close said aperture.



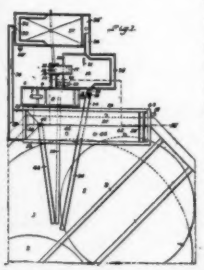
SPARK PLUG. U. S. 1,635,186. July 12, 1927. Jesse T. Littleton, Corning, N. Y. Assignor to Corning Glass Works. Filed 4/25/21. A spark plug comprising a glass core and an electrode, the upper portion of the electrode being of low expansion material, and being sealed to the core, and its lower portion being of material resistant to destruction by arcing and contained in an expansion chamber in the lower end of the core.

METHOD AND APPARATUS FOR BLOWING GLASS PARISONS. U. S. 1,635,716. July 12, 1927. George E. Howard, Butler, Pa. Asignor to Hartford-Empire Co. Filed 9/29/25. A novel arrangement for accurately counter-blowing parisons without the use of the baffle plate or bottom plate. The invention contemplates depositing a charge of glass in a parison mold, settling the glass in the mold by ordinary means, then counter-blowing by air pressure while leaving the charging end of the mold open, and limiting the extent to which the glass may elongate in the mold by causing the expanding glass itself to automatically cut off the supply of counter-blowing air pressure.



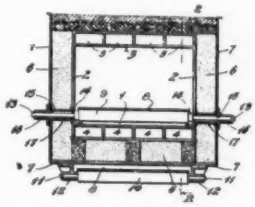
METHOD OF MAKING HOLLOW GLASSWARE. U. S. 1,635,704. July 12, 1927. Robert W. Canfield, West Hartford, Conn. Assignor to Hartford-Empire Co. Filed 3/11/25. The method of making hollow glassware, which comprises blowing a parison and then pneumatically necking-in a portion thereof by producing a differential in the air pressure within and without the parison enclosing said parison in a mold, and blowing it to final form therein.

APPARATUS FOR GRADING SAND AND GRINDING GLASS. U. S. 1,634,254. July 5, 1927. James W. Cruikshank, Pittsburgh, Pa., assignor to J. W. Cruikshank Engineering Co. Filed 5/5/22. In a sand grading apparatus for plate glass grinding machines, the combination with a grinding machine, of a medium coarse sand box, means for delivering sand from the grinding machine to said medium coarse sand box, a concentrator cooperating with said box for successively redelivering sand thereto to effect separation in said box of the medium coarse sand particles independently of the grinding machine, means for delivering said sand from the medium coarse sand box to the grinding machine, a grading box receiving a portion of the overflow from said concentrator, and means for delivering sand from the grading box to the grinding machine.

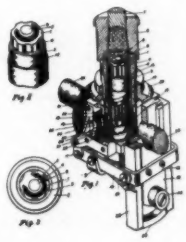


GLASS CUTTER. U. S. 1,634,323. July 5, 1927. Arthur Terry Fletcher, Bristol, Conn., Assignor to Fletcher Terry Co. Filed 1/17/27. Means for operatively supporting the cutter wheel that permit of readily removing the cutter wheel from the frame or supporting body.

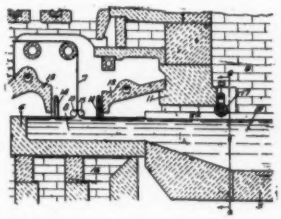
LEHR CONVEYOR. U. S. 1,635,861. July 12, 1927. Karl E. Peiler, Hartford, Conn., Assignor to Hartford-Empire Co. Filed 8/31/25. One object is to reduce the driving tension on the conveyer by minimizing friction between the conveyer and its support. The inventor claims the combination with a lehr embodying a heated tunnel, of an endless conveyer of woven wire fabric for transporting articles of glassware therethrough, a plurality of roller disposed within said tunnel for supporting the ware-bearing strand of said conveyer, and bearings for said rollers disposed without the heated environment of said tunnel.



GLASS-FORMING MACHINE AND PROCESS. U. S. 1,633,634. June 28, 1927. Orin A. Hanford, Columbus, O., assignor to the Federal Glass Co. Filed 4/14/21. Instead of holding blanks by separable fluted jaws, the inventor has discovered that the blank can be firmly held if one of its ends is pressed firmly onto a cylindrical post or into a cylindrical one-piece sleeve. Therefore, he has devised a blank holding device which preferably takes the form of a cylindrical post surrounded by a cylindrical sleeve whose inner wall is in spaced concentric relation to the outer wall of such post. Between these walls and forming a non-yielding base for the space thus formed, he has mounted an ejector sleeve that may be moved forwardly to eject the blank at any time.



DRAWING SHEET GLASS. U. S. 1,634,802. July 5, 1927. James B. Small and Frank J. Kincaid, Charleston, W. Va., assignors to the Libbey-Owens Sheet Glass Co. Filed 5/9/24. In the method of drawing sheet glass wherein molten glass is continuously flowed from a tank furnace into a shallow receptacle, and drawn therefrom in sheet form, the process of removing heat from the glass at the point substantially where it enters the receptacle by placing a heat absorbing body (17) closely adjacent the surface of this glass.



Improvement Relating to Attachment of Iron to Glass

British Patent 259,927, Oct. 15, 1925 (not yet accepted). Application No. 20,256, Aug. 17, 1926. Firm of C. H. F. Müller, 93 Hammerbrookstrasse, Hamburg, Germany, assignee of Frederick Ritter von Raffler, of 10, Ottostrasse, Munich, Germany.

In causing iron to be melted into or onto glass, especially for the attachment of the tubular or cap-shaped metal pieces to the glass wall of vacuum tubes, the thin or sharp-edged rim of the iron portion is melted down into the glass at a low red-heat under slight oxidation. It requires a certain skill to control this process so that the rim of the iron is only slightly oxidized.

According to the present invention this difficulty is overcome by the surface of the rim being provided before the melting in with an extremely thin metal coating preventing the formation of oxide of iron.

A coating of chromium produced by electrolytic means has proved especially suitable. The electrolyte consists here of an aqueous solution of chromium, and the chromium deposit is completed at considerable density of current at from 10 to 15 amperes per square cm. The chromium coating displays an excellent adhesiveness both as to the iron and also as to the melted glass.

New Corporation to Produce Cast Tank Blocks

Corning Glass Works and Hartford-Empire Company Join in Creating Corhart Refractories Company

Important steps have been taken by the Corning Glass Works toward the manufacture on a large scale of the cast tank block recently developed under the leadership of Dr. Gordon S. Fulcher of the Company's physical laboratory at Corning, New York. Announcement was made locally on July 7, through the Corning *Leader* that a new corporation, Corhart Refractories Company, had been created, a factory site acquired at Louisville, Kentucky, and building operations begun. This, it is anticipated, will early next year make available to glass manufacturers and eventually other industries an unlimited supply of the celebrated block which at present can be produced at the Corning plant only in limited quantities.

Perfecting the new product and thoroughly testing it in commercial operations occupied much of the time for several years of the members of the Company's staff engaged in the work. Finally, after success became assured, the first announcement to the glass trade of Dr. Fulcher's achievement appeared in the November, 1926, issue of THE GLASS INDUSTRY. The article illustrated sections of tanks in which the new block had successfully met very severe service tests, and described at considerable length the properties of the block and its development to the commercial stage.

This significant story created world-wide interest throughout the glass and clay industries and the present news that production of the blocks on an adequate scale to meet demands will be a reality within six months will no doubt be received with satisfaction by firms desirous of utilizing the new invention in their own plants.

Details of the new company's personnel and its manufacturing plans are given below, in the statement recently issued by the Corning Glass Company. The first word in the new company's title—Corhart—suggests the two principal interests behind the enterprise.

"One of the most interesting and important of the developments of Corning Glass Works on which its technical staff has been working for several years lies not in the field of special glass compositions nor of glass machinery but in the related field of materials for furnace construction."

"Heretofore the bricks or blocks used to line furnaces for contact with molten glass have been produced from various clays by the ordinary methods of mixing while wet, pressing into shape and drying and burning in a kiln. While great improvement has been made in recent years in clay block quality, the frequent and expensive repairs to furnaces with consequent loss of production form a heavy item in glass manufacturing costs.

"By means of Dr. Fulcher's invention, which is adequately covered by patents in this country and abroad, special clay mixtures are melted and fused in an electric furnace and the molten mass poured directly into moulds similar to those used in the casting of iron. The resulting cast refractory block is ready for use as soon as cooled and is much denser, harder and less permeable than the ordinary clay flux block. These cast blocks, as shown by actual large scale service tests in the furnaces of Corning Glass Works, have several times the life of clay blocks, improve glass quality and aid in solving other glass melting problems. They are a real boon to the glass industry and will unquestionably find a wide market there as well as in many other fields where especially hard service is required of refractory materials.

"Since the production and distribution of this new product would be governed by a wholly different set of conditions from the other lines of Corning Glass Works, it was decided to form a separate corporation and seek a location for manufacture that would be peculiarly fitted to the requirements of the project. The Hartford-Empire Company, of Hartford, Conn., with which Corning Glass Works already had close affiliations in the development of glass working machinery, became a partner in the enterprise, because this company, too, had done significant work in the improvement of refractories for the glass industry. An exhaustive investigation was next made for a plant location that would have not only the industrial advantages usually sought but the special conditions needed for the manufacture of the new product. These conditions are low electric power and a strategic position along the line between the raw material sources and the principal markets in order to give as low a total freight rate as possible. Louisville, Kentucky, was finally chosen. The raw materials come from certain southwestern states and the markets for the finished product are to be found in Ohio, Indiana, West Virginia and Pennsylvania.

"Corhart Refractories Company has now been incorporated with the following officers: President, Alexander D. Falck; vice-president, F. Goodwin Smith, Hartford, Conn.; vice-president, Frederick B. Lincoln, Greenwich, Conn.; secretary, Herbert Knox Smith, Hartford, Conn.; treasurer, John L. Thomas. The board of directors is made up of Alexander D. Falck, Eugene C. Sullivan, W. H. Curtiss, F. Goodwin Smith and Vergil Mulholland.

"Mr. Lincoln, who will also be general manager of the company, has been in Corning for several months supervising the design of the plant, which has been prepared by C. O. Larsen in collaboration with the engineers of Corning Glass Works."

Mr. Lincoln is already established in Louisville, where the erection of the plant is proceeding on a five-acre site purchased by the company. It is expected that the new plant will be in operation by the end of the year.

GORDON SCOTT FULCHER

Born at Evanston, Illinois, 1884, of English parents. Educated at Northwestern University (B. A., M. A.), and Clark University, Worcester, Mass. (Ph. D.) as research assistant to Prof. A. G. Webster. Instructor of physics at Amherst. Instructor, and later assistant professor at University of Wisconsin. Has written numerous scientific articles. Engaged in investigations (1917-1918) for the Navy. Experimental engineer for Bureau of Aircraft Production of the Army (1918) conducted by Dr. R. A. Millikan. Scientific associate of the National Research Council (1919-1920) in charge of Washington office of Research Information Service handling exchange of confidential information between the United States and her recent allies. Managing editor of *Physical Review* for three years. Expert in scientific abstracting and indexing and as such attended by invitation a meeting of subcommittee of League of Nations at Brussels, Belgium, in May, 1923. Joined research laboratory of Corning Glass Works in 1920. Developed with Dr. J. T. Littleton a Pyrex suspension insulator. Developed and patented the process of making cast refractory blocks. Member of numerous fraternities and scientific societies. Dr. Fulcher will continue experimentation at Corning with various compositions of cast refractories.

Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

Analysis of Operation of a Rebuilt Tank

A regenerative glass tank in the plant of the Carr-Lowrey Glass Company, Baltimore, Md., which has given excellent results since being re-designed in 1925 offers some interesting comparisons as to the relative efficiency of old and modern equipment.

Bottles made from glass melted in this tank are of uniformly high quality and are comparable on a favorable basis with the best grades of foreign or domestic ware used for high-grade toilet preparations.

The tank was of somewhat obsolete design before the reconstruction was undertaken. It had eight rectangular vertical ports arranged so that the flame was projected above the bath rather than directly across it. Oil, or producer gas made in old hand-operated producers, was the fuel used. Poor port arrangement and a deficiency in regenerator capacity tended to make melting a slow and costly process.

The Amsler-Morton Company re-designed the tank and supervised its reconstruction. The eight vertical ports were replaced by six horizontal rectangular ports, three on each side. The arrangement was such that the flame was directed downward across the bath over its entire upper surface. A larger regenerator was put on and a Wellman-Seaver-Morgan automatic-type gas producer was provided to replace the former units.

The bath, 14 ft. x 20 ft. x 42 in. deep, remains as originally installed. Walls are of 48-inch flux blocks, 12 inches thick, all horizontal joints being eliminated. A submerged-type throat connects the melting end with the front.

Operating Methods

Gas is generated from coal having an average heat value of about 13,500 B. t. u. per pound in which a recent analysis showed:

Combined carbon	49 percent
Volatile	37 percent
Ash	14 percent
Sulphur	1 percent

The producer blast is at a temperature of 130 to 135 deg. F. and steam is supplied at 25 pounds gage pressure. Gas leaves the producer at about 1,400 deg. F. under a pressure of .67 to .68 inches of water and is burned at the tank with air introduced by natural draft.

The charge, consisting of soda, lime, feldspar, flint sand and cullet, is brought to the rear of the tank on an elevator conveyor and passes in over a magnetic separator.

A pyrometer reading the central tank temperature shows a range of 2,600 to 2,650 deg. F.

Four automatic forming machines are in use and four different jobs are often run at the same time. The tank is kept in actual operation for six 24-hour days each week but the furnace temperature is held constant for periods of about 276 operating days between shut-downs for the renewal of refractory materials.

Comparative Production

The average daily run on the rebuilt tank is 18 tons—50 per cent more than the average attained before the reconstruction.

The maximum tonnage which can be drawn is not a fixed quantity, but there is, for any tank of this type, a maximum above which production can be had only with a reduction in the quality of the output.

The maximum 24-hour demand to date—27 tons—was easily met by the rebuilt tank, with glass of perfect quality. The maximum production obtainable under best conditions was about 20 tons before the changes were made.

Comparative Fuel Rates and Costs

The production data just mentioned are tabulated for convenient comparison and cost data are also shown below.

Oil firing was more economical than producer gas firing under former conditions. The average day's melt of 12 tons of glass required 1,560 gallons of oil which ran 7½ pounds per gallon and 19,500 B. t. u. per pound. The rate, on this basis, was 130 gallons per ton and the unit fuel cost was $7.80 per ton with oil at $.06 a gallon.

About 13.5 tons of coal are now fed to the producer for maintaining the furnace temperature. The unit rate of coal consumption is .75 ton per ton of glass on the average production basis, and 0.5 ton when the furnace is operated near its capacity. Further reduction in fuel rate may be effected by further increasing capacity.

The fuel cost at average production—18 tons per day—is $3.75 per ton of glass with coal costing $5.00 per ton, and $2.50 per ton at capacity operation.

On the basis of the foregoing facts which were obtained in the course of a survey by A. C. Nielsen Company, a neutral engineering firm, in co-operation with Charles B. Garwood, general superintendent of the Carr-Lowrey Glass Company, the unit fuel saving at present average production is shown to be $4.05 per ton of melt—a cost reduction of 52 per cent. The gross saving creditable to the entire rebuilding project is $72.90 a day or $20,120.40 for a year of 276 operating days.

The entire rebuilding cost, including that of the new gas producer, is returned in less than two years by the saving in the cost of fuel.

General Results

The furnace operates better because of the ports having no "tongues" or horizontal divisions between air and gas, resulting in better mixing due to the turbulent action of the rising gas entering the air stream at right angles.

The regenerators have 50 per cent more cross section in the flues for withdrawing the waste gases from the furnace. This reduces frictional resistance to the development of proper hydrostatic pressures required to impress the necessary velocity on the flame entering the furnace, and maintains its flow at or near the surface of the glass throughout the width of the furnace.

The increased producing capacity is an important source of gain because it makes the output of the plant independent of the sizes of bottles being made.

New Motors for General Application

A new type of induction motor which, with its control, is even simpler to operate than the ordinary squirrel cage motor and compensator, was recently announced by the General Electric Company. A complete line of these motors, bearing the type designation FT and ranging in ratings from 7½ to 50 horsepower, has been placed on the market.

The new motor marks the culmination of several years of investigation, development and research by the company in the endeavor to meet the demand for a motor embodying simplicity, reliability, low cost and line switch control involving full voltage starting. While large numbers of high reactance motors of somewhat similar characteristics have been built and applied during the period of development, this, it is said, is the first co-ordination of a complete line for general purpose application.

The FT motor is in general suitable for application wherever the ordinary squirrel cage induction motor with a compensator has been used. It is designed to start on full voltage giving slightly higher starting torque but approximately the same starting current as the ordinary squirrel cage induction motor started with the compensator connected to the 80 per cent tap.

In appearance the new motors are the same as the ordinary squirrel cage induction motor. Rotors are of the cast aluminum type with bars so shaped and located in the punchings as to give a high reactance effect at starting. Starting current is within the N. E. L. A. limitations up to and including the 30-horsepower size.

The advantages pointed out by the builders are low cost, simplicity, reliability, low starting current permitting the use of a line switch, elimination of the possibility of abuse by inexperienced operators, and ready adaptation to automatic control by pressure governor, float switch, etc.

The Glass World and What It Is Doing

News of the Industry

Flint and Lime Glass Manufacturers' Meeting

Due largely to the energetic efforts of President Charles M. Rodefer of the American Association of Flint and Lime Glass Manufacturers, the fifty-first annual meeting of the organization on July 18 at Atlantic City was well attended and successful. Perhaps the announcement of the return for the first time in years to the custom of serving a fine luncheon, which encourages sociability, had some effect on the attendance. At any rate, the occasion was greatly enjoyed and appreciated by those present.

At the conclusion of the luncheon the President first addressed the gathering and then introduced Congressman Frank Murphy, of the sixteenth Ohio district, who made a strong appeal for the support of his listeners to a tariff on glass and glassware adequate to protect the American workman from the unrestrained competition of cheap foreign labor and enable him to maintain his present standard of living.

The meeting then went into executive session to consider several matters affecting the Association's interests.

At the annual election C. M. Rodefer of the Rodefer Glass Company was re-elected president for another year. William T. Gillinder of Gillinder Bros., Inc., was made vice-president, George Dougherty of Economy Glass Company, second vice-president, and E. P. Ebberts of Phoenix Glass Company, re-elected treasurer. John Kunzler, actuary, was re-elected.

An interesting incident was the presence at the meeting of Marshall W. Gleason, president of the Gleason-Tiebout Glass Company, Brooklyn, N. Y., who retired from the presidency of the Association several years ago. Another visitor welcomed by his old friends was Marion G. Bryce, formerly president of United States Glass Company, who now lives in California, but took advantage, during a visit east, to attend the meeting, doing so as a representative of Bryce Brothers Company of Mt. Pleasant, Pa.

CHARLES M. RODEFER

Wage conferences of representatives of the manufacturers with the American Flint Glass Workers Union committees will continue until August 1.

American Ceramic Society's Foreign Trip

A statement was issued on June 28 by the American Ceramic Society, giving the itinerary of the proposed trip to Europe next spring, to which not only members of the Society are invited but others also who would be interested in such an enterprise.

The tour will begin on Saturday, May 19, 1928, at Montreal, Canada, where the members will gather for a "ceramic breakfast" preparatory to boarding a Cunard liner for the trip down the St. Lawrence River, through the Gulf and across the Atlantic. Suitable entertainment will be provided during the trip and informal meetings of the ceramists on board arranged.

Glasgow will be reached on May 27. Side trips will be taken to the Scottish lakes and other points of interest by rail, motor and steamer. The party will then proceed to Edinburgh, Manchester and Sheffield, the home of the Society of Glass Technology and Prof. Turner, its distinguished secretary, and to Stoke-on-Trent and Worcester, visiting glass and ceramic plants at various points.

Then to Birmingham and a tour of Shakespeare's country, with a stop at Oxford enroute to London, where a full week will be spent.

On June 6, the party will go from Harwich by boat to the Hook of Holland. The itinerary will then be as follows: Rotterdam, Delft, Amsterdam, Berlin. Three days will be devoted to the German industries. Dr. H. Maurach and other officials of the German Society of Glass Technology and the German Ceramic Society are planning optional visits to glass and ceramic factories.

Dresden and Meissen will consume two days' time, and three days, June 15 to 17 have been scheduled for Prague. The Czecho-Slovakia Ceramic Society will arrange for plant trips.

On June 18, Nuremburg will be visited, then Munich, then by a rail and steamer trip the party will go to Lucerne. Opportunities for mountain climbing will be offered.

June 23 will find the tourists in Paris where they will stay four days. Col. Bevierre, president of the Master Glassmakers Association of France, and Dr. Leon Yeatman, president of La Ceramiquè, have detailed special plant tours for each of the several industrial interests represented in the party.

Visits will be made to Versailles, Malmaison, Fontainebleau, Rheims and to all places of interest. The final dinner, or "swan song," will be held the evening of the twenty-sixth when a delightful surprise party will be prepared. During the stay in Paris the annual Technical Congress of the French Ceramic Society will be attended. A hospitable welcome awaits the members from the Produits Ceramiques de France.

On June 27, a home-coming Cunard steamship will be boarded at Havre or Cherbourg to arrive at New York on July 5.

Ross C. Purdy, secretary of the Society, says: "We want it plainly understood also that the glass manufacturers are not to be inflicted by prescribed trips to potteries, brick plants, etc. The glass fellows are going to glass plants and are at liberty to make their own engagements and to determine their own itinerary, except that we would appreciate it greatly if they would plan to be at the central points as scheduled for joint meetings of the ceramists of the several countries. There will be mass meetings in London, Berlin, Prague, and Paris, in which all manufacturing groups will take part. The side trips in the interim however are to be planned so as to be of the greatest interest to each specialized group."

The cost of the tour will be $900, including transportation, hotels, meals, etc. Application for further details of the trip and membership in the touring party should be addressed to the American Ceramic Society, 2525 North High Street, Columbus, O., or to Executives' Tours, 25 Broadway, New York.

June Construction Broke All Records

June construction contracts in the territory east of the Rocky Mountains broke all previous monthly records, according to F. W. Dodge Corporation. Building and engineering work contracted

for last month in the 37 Eastern States (including about 91 per cent of the country's total) amounted to $632,478,000. There have been only four previous months that had as much as 600 million dollars in contracts: August, 1925; August, 1926; March, 1927, and April, 1927. March of this year held the previous high record of $620,738,200. The June increase over May was 15 per cent; over June, 1926, 16 per cent.

The June record brought the volume of construction started during the first half of the year up to $3,187,993,300, which is 2 per cent ahead of the first half of 1926. Up to June, this year had been running a little behind last year. It should be understood that building construction has run appreciably, though not seriously, behind last year. Engineering work has largely increased.

Special Sailings for the Leipzig Fair

The great international Trade Fair, which has been held for centuries at Leipzig, will be open this year from August 28 to September 3. More than twenty countries will display their newest products, and buyers, it is said, will be attracted from over forty countries. Germany is making a special effort to develop business relations with America. The fair is held twice annually for periods of a single week. The coming Fall fair will include

A TYPICAL EXHIBIT

some 7,000 exhibits. At the Spring fair this year there were 491 exhibitors of glass, which is always one of the products featured.

American buyers who cross the Atlantic to attend the fair have become so important a factor in tourist travel that special steamer sailings are arranged for their convenience. More than 1,500 buyers, representing a wide variety of interests, journeyed from the United States to Leipzig this year to attend the Spring Fair. The S. S. *Berlin* of the North German Lloyd will sail from New York August 16 to enable visitors to reach Leipzig in time for the Fair. Leipzig is centrally located and a visit to that city can be readily fitted into an ordinary European summer trip.

Trade Association Credit Bureau Functions

The legal aspects of credit bureau functions of trade associations is discussed in an article in *St. John's Law Review*, May issue, by David L. Podell, 111 Broadway, New York, trial counsel and chief special assistant to the United States Attorney in the window glass, pottery and other cases arising under the anti-trust law, and Benjamin S. Kirsch, who is associated with Mr. Podell.

In a summary of the existing situation, the authors say:

"The trade association with its credit bureau performs essentially the same function as the mercantile agency. Indeed, since it does not operate on so extensive a scale, its knowledge with respect to a particular trade, is at times, even more intimate, reliable, and up-to-date.

"It is only fair, therefore, that the credit bureau of the trade association should attain the same measure of legal justification for its activities as the mercantile agency.

"It is because of the lessons we have learned from the law of the mercantile agency, that we are reluctant, for similar reasons, to dismiss the claims of the trade associations merely because they indulge in comments, opinions, and advice. It would unduly restrict the credit function, to permit a scientific collection of credit facts, and at the same time prohibit, under the penalties of law, an expression of a well-founded view with respect to what those facts necessarily imply.

"To that end, honest expressions and opinions in credit matters should be permitted to those empowered by the members of the association to voice them. Such an expression of views should be confined within the limitations of the legal principles which have become fixed by law; that the information should be collected with due care, and distributed only in answer to the specific inquiry of a member or subscriber who has an interest, and to whom there is, therefore, a duty owing by the credit officer of the trade association. Nor, must there be unfair or unjust means employed, or resort made to coercion in the collection of unpaid accounts."

Glass Sand Property Transfers

Changes involved in the organization of the new Pennsylvania Glass Sand Corporation, which is a combination of the eastern glass sand and feldspar producing companies, are believed to be progressing favorably. Reports from the Berkeley Springs district are that transfers of title to property owned by some of the constituent companies have been made, including one by the Maryland Glass Sand Company, Inc., who have deeded 568½ acres of land near Hancock, Md., to the Pennsylvania Glass Sand Company which in turn will deed it to the new corporation. B. S. Randolph is reported to have transferred to the same concern 323 acres of land and J. T. Bridges and F. Wilbur Bridges to have transferred 1,710¼ acres. A. J. Fink, Baltimore, Md., is chairman of the board of the new corporation, William J. Woods, of Lewistown, Pa., president, and H. P. Bridges, of Berkeley Springs and Baltimore, vice-president. The new organization is capitalized at $15,000,000.

Irish Free State Glass Trade

Official returns show the imports of glass and glassware into the Irish Free State during 1926, as follows:

	1926.		1925.	
	Quantity.	Value.	Quantity.	Value.
Domestic and fancy glassware .....cwt.	17,871	$244,205	15,301	$239,055
Illuminating glassware..	.....	178,435	.....	102,420
Plate glass.....sq. ft.	209,143	186,615	208,201	177,320
Other sheet glass..sq. ft.	2,667,880	205,205	2,720,863	243,650
Bottles (dutiable) gross.	80,303	310,440	56,132	231,250
Bottles and jars (non-dutiable) .....gross.	1,174	12,870	33,599	148,620
Glass and glassware, n.e.s. .....cwts.	3,361	99,555	3,567	107,475
		$1,237,325		$1,249,790

Although of the total imports $931,270, or about 75%, are credited to the United Kingdom, it does not follow that the goods are all of British manufacture, the returns only taking cognizance of the ports of shipment. Of the balance of $306,055, $123,535 are credited to Belgium, $128,270 to Germany, $15,665 to Czecho-Slovakia, and $38,585 to "other countries."

Urges Increase in Use of Glass

C. R. MacCann, the well-known sales manager of H. L. Dixon Company, Pittsburgh, Pa., is always "all for glass." He never misses an opportunity of advocating the use of this material even in small ways, and during past weeks has been directing the attention of glass men to their duty of impressing on their dentists the importance of employing glass wherever possible.

The dental profession uses in their operations a small quarter inch round hook-like tube with specially designed head which is hung in the mouth under the tongue to eject saliva during an operation. These tubes are known as saliva ejectors and are operated by inserting into special hose connected with the water mechanism of the dental basin. This causes enough suction to eject the saliva during operations. The tubes are very desirable; in fact the modern dentist cannot get along without them. They

save much rubber damming, are a relief to the dentist, and a comfort to the patient.

Mr. MacCann, however, finds much to his regret that thousands of dentists use a makeshift metal and paper tube which cannot be designed to operate properly (cheap and clogs up) whereas glass tubes can. Glass cleans better than metal, which has a disagreeable metallic taste. The flattened head of a glass ejector allows it to seat comfortably in the mouth and it is hardly noticed. Then, again, the operator can see the saliva ejected, and can tell that his operation will not be flooded with saliva and temporarily spoiled.

"Now then," says Mr. MacCann, "if you would help the glass industry, see that your dentist uses *glass* saliva ejectors."

Chromium Plating Patent Rights Consolidated

Announcement has been made of the formation of a new corporation by leading companies in the electrochemical industry for the consolidation of important patent rights in chromium plating and of the development of a chromium plating process.

General Chromium Corporation, Union Carbide & Carbon Corporation, through its subsidiaries, Electro Metallurgical Company and Union Carbide & Carbon Research Laboratories, Inc., and the Vacuum Can Company, have consolidated their patent rights for chromium plating into one corporation, known as General Chromium Corporation.

The process identified by the patents is called Duro-Chrome.

F. M. Becket, of the Union Carbide & Carbon Research Laboratories, Inc., made the following statement regarding Duro-Chrome:

"The development of the art of chromium plating has been for the past several years an interesting problem for electrochemists. The announcement of Duro-Chrome, which is a result of additional knowledge and improved technique, is of great importance to all industries in which the non-corrodible and wear-resisting properties of plated chromium are of definite value."

To the glass industry the formation of the General Chromium Corporation, sponsored by men who are leaders in the field, gives hope of a solution of the problem of chromium plating of glass molds. It is very probable that the question will have the attention of those in charge of research work of the newly formed corporation.

American Window Glass Launches New Product

An announcement of significant importance as foreshadowing, possibly, an impending revolution in the widow glass field has been made by the American Window Glass Company, Pittsburgh, Pa. in connection with a new ultra-violet ray glass, "Quartz-Lite," which they are now producing. In a pamphlet just issued the point is made that pure fused quartz transmits more of the ultra-violet rays than any other substance and that "Quartz-Lite" contains a higher percentage of pure quartz than any other clear glass used for windows and therefore transmits a greater volume of the ultra-violet rays.

Its cost is but slightly more than ordinary window glass. The price is 50 cents a square foot, f.o.b., Pittsburgh, with freight allowed, by the cheapest route, to all points in the United States when packed in standard packages containing 50 square feet of one size. On orders packed less than 50 square feet to the case a charge of $1.00 for each package is made—the transportation to be paid by the purchaser.

Latest Development in Feeder Litigation

In the patent litigation brought by Hartford-Empire Company against the Nivison-Weiskopf Company involving the glass feeder patents Judge Hickenlooper of the United States District Court of Cincinnati recently rendered a decision refusing defendant's motion to dismiss plaintiff's bill of complaint.

Refractories Institute to Meet in Canada

The Fall Meeting of the American Refractories Institute will be held on Thursday, September 15, at the Clifton Hotel, Niagara Falls, Canada.

Trade Activities

The Long Beach Glass Company, Long Beach, Cal., are preparing, it is reported, to rebuild and enlarge their plant.

The Lancaster Glass Company, Lancaster, O., manufacturers of tableware, tumblers, decorated glassware, etc., is building a new sixteen-pot furnace.

The Pottstown Glass Company, Inc., Pottstown, Pa., was recently incorporated with a capital of $10,000. R. K. Hedrick is treasurer.

The British Hartford-Fairmont Syndicate, Ltd., London, England, has, it is stated, acquired the control of the Miller feeder patents for Great Britain.

The offices of the **Mirror Manufacturers Association,** Harry C. Sorden, secretary, have been moved from 612 North Michigan Avenue to 666 Lake Shore Drive, Chicago, Ill.

Pilkington Brothers, Ltd., have moved their Canadian main office from their Thorold, Ontario, plant to 17 Mercer Street, Toronto, Canada, and all business will be transacted there.

At the **Edward Ford Plate Glass Company's** plant at Rossford, O., on the night of July 11 a fire in one of the older buildings, No. 1 pot house, caused a loss of approximately $75,000.

The American Window Glass Company, according to reports from Hartford City, Ind., have started fires in the big tank in their plant and will resume manufacturing operation early in August.

Ball Brothers Company's, Huntington, W. Va., plant which has been closed since early in the year will probably resume operations some time in August, according to Thomas Morris, general superintendent, who is quoted as stating that about 200 men will be employed when the plant reopens.

The Auburn Glass Company have acquired a site on the corner of 80th Street and Hoyne Avenue, Chicago, Ill., on which they expect to erect a one-story building, 75 by 200 feet, although they report that construction will not start before the first of the year.

The Rolland Sheet Glass Company, Clarksburg, W. Va., are making improvements to their plant including the erection of a steel and concrete addition to cost about $7,500. New machinery will be installed and it is expected that the work will be completed early in September.

The Dayton Lens & Glass Beveling Works, Dayton, O., have acquired a site at 723 South Main Street, but state through E. W. Riley, manager, that the reports to the effect that they are to erect a plant are not correct as they do not contemplate building for at least three years.

The Braddock Glass Company, at La Vale, Cumberland, Md., which began glass making operations on a small scale early in the spring has been placed in the hands of a receiver, Finley C. Hendrickson, who announces that all the assets of the company, including equipment, etc., property and glass products on hand will be offered for sale.

The window glass plant of the **Alley Glass Company,** Salem, W. Va., was sold to V. J. Kuntz, St. Marys, W. Va., for $2,000 at a special commissioner's sale held on July 9. The purchase was made for W. H. Tomlinson, W. B. Stone and Mr. Van Koonse, all of Cameron. The plant will be used for the manufacture of perfume bottles and atomizers and will employ about 135 at the start.

The Libbey-Owens Sheet Glass Company has declared that the regular quarterly dividends of $1.75 per share on the outstanding preferred stock of the company and 50 cents per share on the outstanding common stock of the company, be payable September 1, 1927, to stockholders of record at three o'clock p. m. August 22, 1927.

The Wightman Bottle & Glass Manufacturing Company, Parkers Landing, Pa., resumed operations early in July after a temporary shutdown for tank repairs and the installation of new machinery. An electric lehr of the latest type for handling milk bottles and wide mouthed ware has been installed and replaces the gas fired lehr.

Plans are being prepared to organize the **Morgantown Flat Glass Company,** Morgantown, W. Va., with a capital stock of 2,500 shares of common stock without par value, 3,500 shares of the par value of $100 each of first preferred 7% cumulative stock, 5,000 shares of the par value of $100 each of second preferred 6% cumulative stock. Incorporators are F. O. Garwood, Cleveland; James R. Moreland, Glenn Hunter, Robert A. Kendall and O. S. Chittum, Morgantown.

The Perfection Glass Company, Ltd., Montreal, Canada, manufacturers of non-breakable bullet-proof glass, is reported to have purchased the plant, patents and property of the Toronto Plate Glass Corporation, Ltd., Toronto. The Perfection

Company will continue the operation of the acquired company, adding its special lines to the products formerly turned out in the Toronto plant. James A. Watt is president of The Perfection Glass Company.

The New Cumberland Glass Company, New Cumberland, W. Va., passed into the control of new owners, through the sale of the stock of J. A. and J. E. Brandon and J. L. McFadden. W. G. Edmonds, who has been general manager of the plant, is now president and general manager and Clarence Edmonds has been named secretary. The corporate name will be continued and the same products with some additional specialties will be manufactured. Both the decorated glassware and the chimney business will be extended.

The Blue Ridge Glass Corporation, Kingsport, Tenn., put their new equipment for making cast and rolled glass into operation several weeks ago, producing glass of very good marketable quality within two hours after the first machine was started. C. A. Bowen, of Corning Glass Works, Corning, N. Y., spent six weeks in Kingsport preparing for and making the start. He reports the town to be a hustling place, about 12 years old, with a population of about 15,000 and about 10 reliable industries operating at full capacity.

The Sheffield Glass Bottle Company, Sheffield, Warren County, Pa., was placed on July 12 in the hands of Benjamin P. Hazelton, as temporary receiver. A bond of $100,000 was furnished. The action was brought about by several creditor concerns who claimed that the company owed them sums aggregating $65,000. A short time ago the Sheffield company's Wilcox, Pa., plant was taken over by the **Knox Glass Bottle Company** of Knox, Pa., under a lease, with an option to purchase, and the latter company is now operating the plant which is equal in size to their own plant and is fitted for the production of amber glass and a miscellaneous line of drug glassware. The acquisition of the Wilcox plant has increased the production of the Knox company about 20 per cent. All business will be transacted for the Wilcox plant at the general offices at Knox.

Personals

Ernest Nickel, vice-president and treasurer of the United States Glass Company, Pittsburgh, Pa., recently resigned from that company. Mr. Nickel had been in active service with the company for about 36 years.

John William Lamparter, factory manager of the **Imperial Glass Company,** Bellaire, O., has resigned and will be succeeded by **Charles E. Morris,** of Wheeling, W. Va., who was a former manager of the plant. The tank which has been in operation at the plant has been suspended for an indefinite period but the two furnaces will continue to operate, the employes to share in a division of time.

Recent Deaths

Theodore Schmitt

Theodore Schmitt, aged 69 years, of Carrick, near Pittsburgh, Pa., died on July 3rd. Mr. Schmitt had been a life long resident of Pittsburgh and for 20 years prior to his retirement seven years ago, was superintendent of the D. O. Cunningham Glass Company.

What Our Advertisers Are Doing

A new system of plant control of all manufacturing processes has recently been adopted by Vitro Manufacturing Co. of Pittsburgh, Pa., manufacturer of enamels, colors and chemicals for the glass industry. A rearrangement of the personnel in charge of operations has been made to bring each step in production directly under laboratory control.

Harold V. Huber, as chief chemist, is in complete charge of the plant. He is assisted by the following:

Harold F. Bopp, who for many years has been engaged in plant work in the pottery industry, is in charge of coloring oxides, pottery glazes, etc. E. M. Fleck, formerly of Standard Chemical Co., supervises analytical work and has charge of zirconium products, opacifiers and investigation of rare metals. Thomas M. Felton, lately instructor in ceramic engineering at Ohio State University, takes care of the production of enamels, vitrifiable glass colors and service to enameling and glass plants. Henry Sheerer is in charge of the production of gold for decorators and assists Mr. Fleck in general analytical work. George Wright, recently of the Art Aseptible Co. of St. Louis, is in charge of operation and production. H. C. Roth, formerly chief chemical engineer of the Chemischen Fabriken Rhenania, Manheim, Germany, is in charge of furnaces and equipment.

The staff is housed in a new laboratory building equipped with the latest scientific apparatus.

Coming Meetings

AMERICAN REFRACTORIES INSTITUTE will hold its fall meeting at the Hotel Clifton, Niagara Falls, Canada, on September 15.

THE NATIONAL GIFT AND ART ASSOCIATION will hold its fall exhibition at the Adelphia Hotel, Philadelphia, Pa., August 22 to 27, 1927.

THE AMERICAN CERAMIC SOCIETY'S next annual meeting will be held at the Ambassador Hotel, Atlantic City, N. J., February 5 to 11, 1928.

THE ELEVENTH EXPOSITION OF CHEMICAL INDUSTRIES will be held in the Grand Central Palace, New York, N. Y., September 26 to October 1, 1927.

EASTERN DIVISION OF NATIONAL GLASS DISTRIBUTORS ASSOCIATION will hold its fall meeting at Atlantic City, N. J., September 21, 22 and 23.

What The World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

Denmark: 26217, opal glass.
Ecuador: 26371, glass, concave, for photographic enamels.
Canada: 26368, glass fruit jars and glass stoppers.
Argentina: 26375, glass marbles.
China: 26384, glass, plate, large quantities, semi-white window, frosted, and green and red glass; water-level tubes and klinger tubes for locomotives.
Columbia: 26497, glass window.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, JUNE 22, 1927
Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Machine, Com.	..	..	38
American Window Glass Machine, pfd.	..	..	70¼
American Window Glass, pfd.	..	..	104½
United States Glass	12½	..	12
Pittsburgh Plate Glass, com.	..	..	230
Standard Plate Glass, com.	..	..	3
Standard Plate Glass:			
Preferred cumulative	..	..	12⅛
Prior preferred	..	..	33

TOLEDO STOCK EXCHANGE, JULY 23, 1927

	Bid	Asked	Last
Owens Bottle Machine, com.	116½	117¾	117½
Libbey-Owens Sheet Glass, com.	133	135	134½
Libbey-Owens Sheet Glass, pfd.	115	...	118

WHEELING STOCK EXCHANGE, JULY 20, 1927

	Bid	Asked	Last
Hazel-Atlas	...	...	63
Imperial	...	...	72
Fostoria	...	...	208
Central	...	...	75

Current Prices of Glass-Making Materials

July 22, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.		..	1.05-1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.37	.37
Alcohol, denatured	gal.	..	.42
Aluminum hydrate (Al (OH)₃)	lb.	.04½-.05	.05-.05½
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.		.19-.23
Ammonia water (NH_4OH) 26° drums	lb.	..	.03¼
Antimony, metallic (Sb)	lb.	..	.12
Antimony oxide (Sb_2O_3)	lb.	..	.15¾-.16½
Antimony sulphide (Sb_2S_3)	lb.	.14	.15
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03¾-.04	.04-.04¼
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04	.04¼-.04¾
Boric acid (H_3BO_3)	lb.	..	.08-.09
Refined	lb.	.08-.08¼	.08½-.08¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	.	.30
Cryolite ($Na_3Al\ F_6$) Natural Greenland			
Kryolith)	lb.	..	.09½-.09½
Artificial or Chemical	lb.		.08½-.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.			1.15-1.30
Feldspar—			
100 mesh	ton	11.00-20.00	15.50-22.00
80 mesh	ton	..	14.50
40 mesh	ton	12.50	13.50
Fluorspar (CaF_2) domestic, ground, 95–98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.09¾	.10
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.03½
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.10	.10¼
Litharge (PbO)	lb.	.09	.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08½
Manganese 85% (MnO_2)	lb.	.04½	.05
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08⅝
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06⅝	.07½
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07¼	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.14	.14½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.41
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½-1.27½	..
In barrels	Per 100 lb.	1.55-1.57½	2.40
In bags	Per 100 lb.	1.37½	..
Spot orders	.05 per 100 lbs. higher		
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	..	3.50
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03¾	.04
95 per cent	Per 100 lb.	2.50	2.75
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¾	.05
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.44½	.45
Tin oxide (SnO_2) in bbls.	lb.	.68	.70
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to June 24, 1927

	May 1926 Quantity	May 1926 Value	May 1927 Quantity	May 1927 Value	Five Months Ending May 1926 Quantity	Five Months Ending May 1926 Value	Five Months Ending May 1927 Quantity	Five Months Ending May 1927 Value
Glass and glass products (total)	.....	$792,369	.....	$733,741	.....	$3,662,978	.....	$3,625,941
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,682	18,078	1,258	9,277	16,053	87,190	8,200	50,132
Plate glass, unsilvered, sq. ft.	94,193	31,652	10,972	5,950	596,746	142,497	448,859	135,536
Other window and plate glass lbs.	170,242	20,428	580,063	66,979	913,904	93,085	1,899,523	184,158
Glass containers (bottles, vials and jars)	.....	245,524	.....	252,745	.....	1,138,069	.....	1,195,244
Table glassware, plain	.....	146,511	.....	116,178	.....	673,233	.....	630,193
Table and other glassware, cut or engraved	.....	14,270	.....	15,137	.....	80,683	.....	58,932
Lamp chimneys and lantern globes lbs.	223,069	38,372	147,078	36,496	988,195	183,917	881,665	186,295
Globes and shades for lighting fixtures lbs.	161,543	49,469	148,270	50,730	717,909	230,753	685,049	257,649
Chemical glassware lbs.	15,319	14,151	15,789	12,918	94,950	86,363	69,952	65,771
Electrical glassware, except for lighting lbs.	686,582	52,271	201,915	17,836	2,404,325	218,499	986,032	97,016
Other glassware	.....	161,643	.....	149,495	.....	728,689	.....	765,015

IMPORTS

Corrected to June 24, 1927

Glass and glass products	.....	1,750,953	.....	1,384,980	.....	8,391,002	.....	6,887,207
Cylinder, crown and sheet—								
Unpolished dut. lb.	7,678,711	338,746	.....	.....	31,286,522	1,420,468	.....	.....
Weighing less than 80 pounds per case dut. lb.	.....	.....	4,387,640	109,545	.....	.....	21,900,314	562,388
Weighing 80 pounds or over per case dut. lb.	.....	.....	4,095,518	164,400	.....	.....	17,904,154	810,355
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	64,608	.....	28,645	.....	253,888	.....	167,149
Plate glass dut. sq. ft.	2,263,886	727,787	.....	.....	11,767,095	3,829,899	.....	.....
Polished, unsilvered dut. sq. ft.	.....	.....	1,701,444	435,750	.....	.....	7,316,520	2,215,564
Other plate glass dut. sq. ft.	.....	.....	141,693	22,685	.....	.....	478,288	121,621
Containers—bottles, vials, etc dut.	.....	25,191	.....	12,029	.....	118,321	.....	82,642
Table and kitchen utensils dut.	.....	10,168	.....	10,851	.....	29,921	.....	47,992
Glassware, cut or decorated dut.	.....	175,738	.....	274,795	.....	944,298	.....	1,355,704
Blown glassware, n. e. s.—								
Bottles, ornaments, etc dut.	.....	142,097	.....	64,064	.....	426,219	.....	306,405
Bulbs for electric lamps dut.	1,221,692	15,033	789,870	8,876	8,431,388	98,614	6,368,635	58,902
Chimneys, globes, shades, etc dut. No.	.....	77,771	.....	71,907	.....	435,975	.....	358,864
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	50,889	.....	52,022	.....	233,944	.....	218,957
Other glassware dut.	.....	122,925	.....	129,411	.....	599,455	.....	580,664